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Steel Case Decision

IT IS NOT far from the facts to say that there was universal rejoicing at the decision of the United States District Court for New Jersey last week refusing the petition of the United States Government to dissolve the United States Steel Corporation. The court held that the corporation, in acquiring its foreign and home trade, did not violate the Sherman anti-trust act and refused all the injunctions prayed for by the Department of Justice. When the suit was started it was freely predicted by those who had followed closely the workings of the corporation, that this would be the result. The corporation has stood for fair dealing and in the popular mind was considered the very antithesis of the Standard Oil Company. It is well for American business that the corporation has successfully withstood the Government prosecution.

Conservancy Law Valid

ENGINEERS throughout the country will extend their congratulations to the citizens of Dayton and of the Miami Valley upon the final approval by the Ohio Supreme Court of the conservancy law, designed to permit of the joint construction of flood-prevention works. The matter has been in litigation for over a year, coming twice before the Supreme Court. In the first discussion of the law before that body the Court ruled that the legal proceeding was not proper, the case having been brought up on appeal instead of on writ of error. Fortunately proceedings in accordance with the latter course were then in progress and it is this case which was decided June 4. The law is declared constitutional and under it the great work planned for the protection of the Miami Valley, and described at length in these pages during the past year may now proceed. Though long deferred the victory is a great one and means much to the citizens of Ohio.

Mont D'Or Tunnel Opened

TO the list of notable railway tunnels in operation in Europe a new name has been added—the Mont D'Or. Robbed by the war of the publicity which so important an event would receive in normal times the international railway link between France and Italy, via Switzerland—15 miles long, including the 3¾-mile tunnel—was opened to traffic, without ceremony, on May 15. To the layman the news means the shortening of the route from Frasne to Vallorbe by 11 miles, eliminating the detour to Pontalier by the old line, but to the engineer the event marks the termination of a five-year struggle against unusual difficulties. From Frasne the double-track line extends, in the open, across a marsh where thousands upon thousands of yards of material were swallowed by the ooze before a stable embankment was secured. But the trouble did not stop here, for in the tunnel excessive inflows of water were encountered, causing the collapse of sections of the roof and threatening to stop the work. Finally an aqueduct had to be built within the bore to carry off the water. In spite of these handicaps the work was continued, and its completion is a tribute to the courage and endurance of the men who have made the Mont D'Or route more than a mere black line on a tracing. The motive power through the bore will be steam, but the ventilation is said to be so perfect that the locomotive gases will cause practically no inconvenience. While the original estimate placed the cost at about $7,500,000 it is believed that the unusual difficulties encountered have almost doubled the figure.

Automobile Speedways

NOTICEABLE differences in the design of automobile racing speedways will be found by a comparison of the article on the new Chicago speedway in the issue of May 29, page 686, and the description of the design of the Sheepshead Bay track, New York, page 739 of this issue. Both are of the same length, two miles, of practically the same width, averaging 70 ft., and the timber flooring for both is 2 x 4-in. plank set on edge and laid longitudinally. In all other design details, however, there are marked differences. It should be noted that the flooring of the New York track is not attached in any way to the supports. This invites disaster if the wind pressure under the flooring at the turns should ever exceed its dead weight and the small arching resistance to overturning. Although the yardage of concrete is 12,000 for both tracks, the floor of the New York track is supported on 8-in. concrete cross-walls on the straightaway and steel frame construction on concrete piers at the turns. In addition 8-in. longitudinal concrete walls inside and outside are used. The Chicago construction, on the other hand, required only the 7500 concrete piers, supporting timber construction throughout. This timber construction made possible the six-weeks' record for erection, and required 9,000,000 ft. of lumber, which is three times that for the New York track, the added 6,000,000 ft. being offset by the 1570 tons of steel required in the Sheepshead Bay track. The most striking difference, however, is the curved banks on the turns used in the New York track, thus allowing much lower and also much higher speeds than the straight banks of the Chicago track. This is claimed to be the only track in America built on these scientific lines. The Brooklands track in England is built on the same principle, and designed for the same speed, 96 miles. There is every reason to believe that the carefully computed transition curves and smooth surface of the New York track should result in new speed records when it is completed in the Fall.

Tax the Grade Crossings!

GRIEVED that the railroads in its vicinity are not rushing into the expense of eliminating grade crossings under the New Jersey law that saddles the entire expense on them, the Atlantic City "Review" proposes that each grade crossing be taxed $100 per annum, or more if necessary, the money to be devoted to grade-separation work. Apparently, it is necessary before levying a tax to fix the ownership of the property. If the railroads own the crossings they had better close the streets. As the "Review" implies that money would be collected from the railroads, evidently it does not vest in the municipalities sole ownership of the crossings. Hence they must be joint property, and the tax would have to be a joint affair. This reduces to about what the railroads are contending for—joint participation. The "Review" admits total failure to meet the grade-crossing problem in New Jersey. Naturally the railroads will fight to the last ditch the attempt to make them assume the moral obligations of State and municipality as well as their own. When New Jersey awakes, as some of her more enlightened neighbors have, to the fact that she is equally responsible with the railroad for the grade crossing, elimination will be resumed and the tragedies of those who fail to stop, look or listen will become less frequent.

Remodeling Old Septic Tanks

THE RECONSTRUCTION of old septic tanks into two-story Imhoff tanks is an interesting development in sewage-treatment progress. Columbus has considered the proposal, and a few small tanks have already been converted into the Imhoff type by the addition of flowing-through baffles. The great difficulty is that most of the older tanks are not sufficiently deep. At Orange, Cal., as described in this issue, the tanks were exceptionally shallow and still they appear to be giving satisfactory service, the characteristic slight marshy odor being obtained from the digested sludge. Undoubtedly the even temperature of Southern California makes the bacterial action more vigorous and such good results might not obtain under similar conditions in a less arid climate. The old tanks are interesting, also, for another reason, in that they brought out clearly that the relation between water-supply and sewage-treatment works is not only one of quantity. The mineral content of the water unfortunately spelled failure for septic tanks of good design. The water contains 150 to 500 lb. of dissolved sulphur, in the form of sulphates, in each million gallons. As a result, desulphurizing bacteria, growing in the sewage detained in the septic tank, charged the effluent with the noisome gas that renders an ancient egg notorious. No judge and jury are needed to decide the merits of the case when a septic effluent charged with sulphuretted hydrogen is used for irrigation.

Economics of Sand Testing

RAPID as has been the increase in appreciation of the need of sand testing, the majority of engineers and contractors still fail to realize its importance. To them it appears a profitless refinement. The fault lies not alone with those who hold this opinion, but also with those who have advocated sand testing and have discussed it before engineering societies and in the technical press. Intent with the details of methods they have failed to interpret the usefulness of tests in language appealing to those who have only a bowing acquaintance with the laboratory. In this issue the Engineering Record begins a series of articles which should help to acquaint contractors and engineers with the economic side of sand testing—with the possible benefits to contractor and owner, unrealized now because sand testing is stigmatized as a "high-brow" diversion.

The first article endeavors to connect up sand testing with the chief of the contractor's interests—profit. It is not to be understood that an additional profit is promised in every case, but the authors endeavor to indicate in what manner savings may be made possible through the interpretation of results. It is true that in some cases sand testing will result in the rejection of sands from certain sources, or at least prohibition against their use in their raw state. Should this rejection come during the middle of a job, as a result of continued testing, a hardship, under present methods of specifying sand, would be worked upon the contractor. However, the day is not far distant when the latter will find it necessary to assure himself in advance of the quality of the sand he proposes to use, just as, when there is intelligent inspection, he must be certain that he can secure the quality specified for any other material. Apparently, too, sand specifications must be rewritten in order that the contractor may know just what he must supply.

In the last analysis, it is evident, adoption of a proper control of the sand will depend upon the owner and the engineer. The contractor will have to comply with the specifications under which he bids. It is vital, therefore, that users generally should become thoroughly conversant with the object of sand testing and its place in securing better concrete. At the same time, it is desirable that the contractor, too, should appreciate the problem; for such appreciation must be the forerunner of anything more than a forced compliance on his part with the more modern specification.

The series beginning in this issue should do much toward spreading sound knowledge on sand testing. The articles are practical and will appeal to those who have heretofore been unimpressed by laboratory refinements. The series, this journal believes, is the best presentation which has yet been made of the subject.

Unit for Track Depreciation

THE CONCEPTION of the railroads as to the proper treatment of depreciation, as expressed by Judge W. G. Brantley at the recent valuation conference in Washington, is precisely what this journal has long held to be correct. The judge, moreover, put forward a very reasonable suggestion for getting around the seeming requirement of the Valuation Act that actual deterioration of the physical units must be reported, whether or not such deterioration had reduced the value of the plant as a whole. His idea was that as far as track was concerned the rational unit was not the rail, the tie or the bolt, but the unified track itself. As he pointed out, a piece of track only reaches its maximum value when it has been in service for years, is thoroughly seasoned and is being renewed in definite cycles, and it is grossly unfair to mark down the paper value in these first few years while the real value is increasing.

A rather startling illustration was drawn in the case of ties. Statistics indicate that there are more than a billion ties doing duty in the country, to reproduce which would cost perhaps $1 apiece. Most of the railroads took several years in building, which means that by the time they were completed the service life of each tie would have been materially shortened and several hundred million dollars would have been permanently written off. This deduction would subsequently have increased until it reached $500,000,000 or more—measured in terms of a standard of track that never did exist and would not make for successful operation if it did.

There is another argument, not put forth at the conference, for making the track itself the unit with respect to depreciation. There is no disposition, so far as this journal is aware, to measure the deterioration of the individual structural shapes in the bridge, or the amount of disintegration of each stone in the abutments. These are parts of the structure, and it is the service life and value of the structure as a whole that is under consideration. In like manner the ties, rails and spikes are part of the track structure. That the service life of some railroad structures is hard to estimate is suggested by a question left unanswered at the conference, as to how the service life of a station building should be determined. But there need be no such uncertainty as to the track. Its service life is infinity. It requires constant maintenance, one form being the tightening of nuts, another being the replacement of worn-out with new ties, but the track remains unimpaired unless there has been deferred maintenance.

It seems to this journal, therefore, that the Division of Valuation can conform to the letter of the Valuation Act without recording the aging of ties and rails as depreciation. If the division decides otherwise it is to be hoped that it will make the facts perfectly clear, so that in any case in which the courts depend on the valuation reports no technicality will prevent the finding of true value.

Temperature Variations in Concrete

DURING the discussion, at the meeting of the American Society of Civil Engineers on May 5, of the paper on temperature changes in mass concrete by C. H. Paul and A. B. Mayhew, which was abstrated on page 710 of last week's issue, mention was made of another investigation of this important subject. W. F. Smith and George T. Seabury described in some detail the installation of nearly fifty thermophones in the new Kensico dam of the Catskill water supply. Some of them have been in place 18 months, and many over a year, yet it was stated that the effect of chemical heat, apparently, has not yet wholly disappeared.

The cyclopean concrete (a 1:9 mixture, with 25 per cent large stone) was placed very rapidly. In contrast with the methods used at the Arrowrock dam, the thermometers were plunged into the new concrete as it was being poured, and covered deeply in a relatively short time. The main object was the determination of the maximum temperature developed by chemical action and a rise of 40 deg. was recorded near the center of the dam, as compared with about 38 obtained in the Arrowrock. This increase in temperature was developed within 5 to 30 days. Mr. Seabury stated that the speed of placing probably does not affect this temperature, provided several feet of concrete cover be placed over the thermometers, and that much higher temperatures than those found in the Arrowrock Dam have been reported—up to 118 and even 135 deg.

Two distinct problems are involved in these investigations, requiring different lines of procedure and study. The first is concerned with the determination of the maximum temperature in the interior of a mass of concrete due to chemical action during setting, and with the relation of time of setting and amount of shrinkage to the duration of this temperature. The second is the practical question regarding the magnitude of temperature stresses in structures subjected to widely varying temperatures of the atmosphere. Both problems merge into the analysis of the causes of temperature cracks and the necessity of providing joints in monolithic construction.

It is evident that most attention has heretofore been given to the determination of internal temperature due to setting. This journal, on the other hand, would emphasize the practical importance of exact knowledge of the temperature at the surface and at points a few inches below, not only in dams but in other structures. Readings should be obtained at a sufficient number of points to give the actual values at adjacent portions of the structure and its supports. It would seem unnecessary to state that temperature stress results only from the prevention of free expansion and contraction under temperature variation, yet textbooks contain fallacious reasoning on this subject, based upon unwarranted assumptions of complete restraint, and neglect of the influence of variations in temperature of adjacent material. This, perhaps, may explain the well-known wide diversity of opinion among engineers regarding the necessity for any expansion joints whatever, as well as the variations in practice in the placing of such joints.

The final results of the studies of these investigations, which are to be fully prosecuted after more trustworthy seasonal variations are determined, will be anticipated with deep interest. It is hoped that the new thermometers will continue to give satisfactory service and not deteriorate as in the previous investigation at the Boonton dam, but it seems unfortunate that none is placed closer to the external face than 1 ft. Careful study should be made of relative temperatures of adjacent parts from the surface inward, of the effect of shear stress developed by unequal temperature strains, and of the relation between shrinkage and true temperature strain. The relative amount and duration of the initial heat due to setting of green concrete should be considered in their relation to external cracks accompanying wide variations in the temperature of the air. It should be recognized that each structure requires its own special analysis. The initial basic requirement, however, is clearly the values for actual temperature changes for adjacent parts of the structure. These investigations promise to provide valuable data, and it is to be anticipated that succeeding analyses of these data will furnish a scientific basis for more exact allowances for temperature stresses in the design of monolithic concrete structures.

Town as a Road Contractor

NOVEL, although not unprecedented, is the situation which has been created by the award of a contract for a New York State highway, between Quogue and Southampton, Long Island, to the Town of Southampton, as noted in this journal last week. The municipality bid for the work in competition with contractors and submitted the low tender. While other municipal corporations have bid on small work this is the first large road-building contract—amounting to $113,000—which any of the New York towns has undertaken. The road will be built under the State-aid plan, the State paying 65 and the county of Suffolk 35 per cent of the cost.

The conditions which led the town to assume the role of contractor are, briefly, the following: It wished to construct a 20-ft. highway, instead of the 16-ft. road provided for, and by assuming direct charge of the work it was thought that the dangers of any "hold-up" by a contractor would be eliminated. Many men in the community are idle and it will now be possible to give them employment. The town, also, controls the best local sand and gravel banks. An appropriation of about $30,000 has been voted for the purchase of plant to supplement that already owned.

It remains to be seen, however, whether this policy will prove economical in the long run. While some cities have made a success of day-labor work the general experience has been that contract work is cheaper. If towns are to bid in competition with contractors it will be instructive to know exactly upon what basis their bids are prepared, whether their prices represent the real cost of doing the work. If no allowance for profit be made and it is assumed that a town force can work as efficiently as a contractor's crew, the town's bid prices will, of course, be low. But there are other things to consider. In the matter of plant the contractor must make an allowance for interest on investment and depreciation. If the town does not do likewise its figures will be misleading and apparent first economies will be offset later by some form of tax levy to make up deficiencies directly chargeable to the first cost.

It is not claimed that Southampton has neglected these factors but, in general, to arrive at a true estimate of the relative costs of day-labor and contract work these items must be taken into consideration.

Spanish for the Engineer

CAPABLE engineers with a thorough grasp of Spanish are apparently to be offered exceptional opportunities by the developments which it seems quite certain are to come soon in the relations between this country and Latin America. The recent Pan-American Financial Conference marked an epoch in those relations. It brought out the community of interests between the countries represented. It indicated that American money will be made available for projects in the countries to the South. With such investments will come calls for American engineers of proper training.

The conference was conducted along lines most gratifying to the important statesmen, financiers and business men from the nineteen countries represented. Politics was completely sidetracked. The group conferences, which occupied most of the week, were handled as strictly business meetings. Each of them was attended by a few representatives of the respective countries and several financiers and business men as United States delegates. Each group got right down to individual cases regarding the hindrances to broader trade relations between the country in question and this Nation. Need of more and better steamship lines, capital requirements, lack of mutual understanding of business methods and similar subjects were all discussed specifically. The foundation was thus laid for the work of the several permanent international commissions which are to continue the elimination of all such hindrances to reciprocal trade between the United States and the South and Central American countries.

The lack of any knowledge of Spanish on the part of most of the United States representatives at the conference was very noticeable. On the other hand, many of the Latin American delegates spoke English fluently. It is well known that the Europeans who do business in Central and South America use Spanish well and understand fully the customs of the countries in which they operate. Indeed, these Europeans become a part of the social and business life of those countries. What our financiers, business men and engineers must do to meet such a situation is plain.

Frank A. Vanderlip, president of the National City Bank, New York, has pointed out to an Engineering Record representative that the lack of men who have a working knowledge of Spanish, along with ability in international finance, is one of the chief handicaps to the establishment of branches of his bank in Latin America. When bankers of such combination training are found, few of them are available. This is chiefly because the opportunities for them here are large, on the one hand, and, on the other, because they do not care to live abroad. Mr. Vanderlip is of the opinion that the same situation applies to practically all lines of business, and to engineering as well.

A similar opinion frequently has been expressed by J. G. White. In fact, he has gone so far as to establish prizes at Cornell University and at Pennsylvania State College for students most proficient in Spanish. The very wide experience of Mr. White's organization in the Philippines and in Latin America has convinced him of the urgent need of training in Spanish for American engineers.

Similar evidence without end could be furnished from other authoritative sources. The demand for engineers trained in Spanish is certain. Adequate means for meeting this demand apparently have been provided only in a very few of our engineering schools. Indeed, it seems that scarcely any of our engineering educators have sensed this demand in its full significance. Certainly Spanish courses of proper character for engineering students are provided only in a limited number of institutions. At the University of Michigan it may be noted Dean Cooley has for years been an ardent advocate of Spanish, as against German or French, for the very reasons here advanced.

This is the time for action by our technical schools on this very important subject. Their curricula for the next year are now being or soon will be adopted. These should include practical courses in Spanish. Mere academic study of eighteenth-century Spanish literature will not suffice. Consideration must be given to present-day Spanish business customs and affairs. Engineering reports and investigations prepared in Spanish should be studied. In a word, the course should be 90 per cent efficient for the engineer and not mere academic training. Moreover, student advisers should point out next fall, to freshmen and sophomores particularly, the opportunity in the years to come for engineers who have a thorough knowledge of Spanish.

The Economic Side of Sand Testing

A Series of Three Articles, of Which the First Emphasizes the Practical Nature of the Subject and Shows How Such Testing Effected a Large Saving for One Contractor and Secured a Better Concrete

By **CLOYD M. CHAPMAN**, Engineer of Tests, Westinghouse Church Kerr & Company, New York,
and **NATHAN C. JOHNSON**, Consulting Concrete Engineer, New York

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IN spite of the oft-repeated utterances of competent authorities, made with growing emphasis year after year, as to the importance of testing sands for use in concrete construction, it appears that little actual headway has been made towards convincing the average concrete constructor that such tests are either a benefit or a necessity, or that they have other than a theoretical importance. This attitude is unfortunate, but since it exists, it may be well to give heed to it and inquire whether or not it has justification, with a view to removing the cause.

GROWING APPRECIATION OF PROBLEM

There has, however, been a steadily increasing appreciation of the value of sand tests, and this appreciation finds expression in the fact that some of the largest engineering organizations, municipal and public service laboratories, and State and Federal undertakings employing large quantities of concrete, make a regular practice of testing the sands used in their work. In addition, some of the States have taken up the subject through their State geologists and have made qualitative and quantitative surveys of the available sand deposits within their borders. Many colleges and universities are also including sand studies in their curricula; and some of the Portland cement manufacturers are closely studying sands with an understanding of their importance in making better concrete. Both of the great technical societies most interested, the American Concrete Institute and the American Society for Testing Materials, now have standing committees on the subject.

Yet, in spite of all this educative effort the men who use most of the cement produced in this country, still believe that "sand is sand" and that there is no need of testing it.

"LET THE BUYER BEWARE"

Concrete making, then, as practised in the year 1915, remains essentially as in its earliest days—the more-or-less haphazard mixing of a certain dry powder with water and near-at-hand materials taken from the ground, regardless of past misadventures resulting from such practice. This is essentially true, whether the maker be a practical man without technical training, or a college graduate. Contractors are mixing concrete not for fun, but to make money; and it is assumed essential in the art of making money that goods shall cost as little as possible, consistent with satisfying the customer; and that the doctrine of "caveat emptor", or "let the buyer beware", shall apply. In nine cases out of ten, the contractor satisfies his customer, gets his money, has his profit and has apparently done a good job. Whether or not it is equally good a year, or five years, or ten years hence is not considered as his concern. In the tenth case, however, something is so radically wrong that the materials refuse absolutely to become concrete. When that occurs, the contractor does a little worrying and may possibly call for expert aid, but not if he can help it.

The attitude of the average concrete man is well reflected in the words of a superintendent on a large job to an engineer who objected to the use of five carloads of dirty stone after they had been condemned. "That's all very nice," said this practical man, "but you know and I know and we all know that you can't tell the difference between dirty stone and clean stone after it's in the wall."

EDUCATIONAL WORK NEEDED

The testing laboratory, to such a man, is an interference, complicating a well-known game with senseless rules that force it to be played differently and at a cost for which he may see no return. Is the work done under such new rules any better in first appearance? Very rarely. Will it bear any heavier load? That is almost impossible to determine. Does it cost more? Possibly. Has it greater endurance?

To answer this last question convincingly is difficult. It is known, however, regardless of assertions to the contrary, that there is evident on all sides a deterioration of concretes made under free-for-all conditions, which shows that something is deplorably wrong with such a product. By painstaking study and investigation it has been shown that there are certain definite and determinable causes, usually aside from the cement used, which bring about such failure; and that in many instances these causes lie in the character or quantity of the aggregates used, this being particularly true as regards the fine aggregate, the sand. To determine these causes, however, requires laboratory procedure, and unless the difficulty is serious—so serious as to inhibit the use of that particular material under any circumstances—it is questionable if considerations of quality or permanence will outweigh the primary and fundamental question of dollars and cents. Obviously the remedy lies fundamentally in educating all parties, owners, engineers, contractors, to such an appreciation of the benefits of proper construction and the difficulties attendant upon proper execution as to cause them to take care of the financial element in the preliminary estimate. This education will probably be a slow process, but in the hope that something of value may be contributed towards this end, these articles are undertaken.

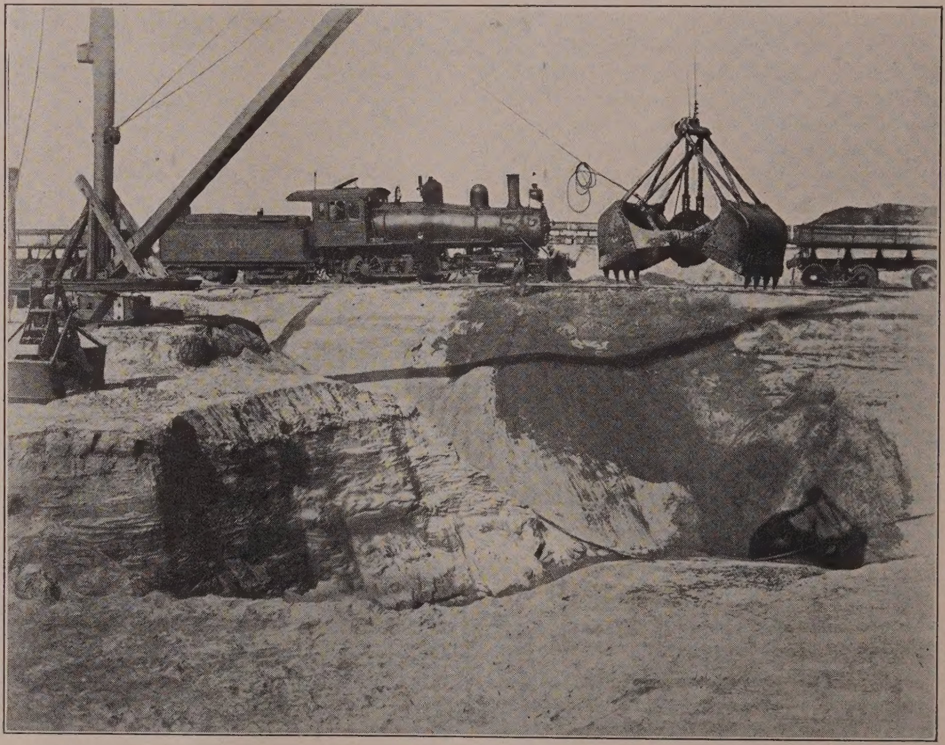


FIG. 1—JUST SAND—BUT POTENT FOR PROFIT OR LOSS TO CONTRACTOR AND OWNER

SELECTION OF AGGREGATES

There are several important considerations to be observed in the selection of aggregates for concrete:

1. The materials entering into concrete must be of such structure and quality as to suit the use to which the concrete is to be put. Aggregates should remain in unaltered physical state so long as the concrete endures. Some materials do not fulfil these conditions.

2. Aggregates used in concrete should be

so graded as to give a mixture of maximum density, strength or impermeability as required. A sieve analysis will show how the sand being tested compares with the grading of Fuller's curve, which is generally considered as a good criterion. As sands rarely if ever occur so graded in nature, the quality of concrete desired may be approximated by so proportioning the stone and cement as to best utilize the sand or sands available.

3. The aggregates selected should be free from deleterious matter and should show a definite strength when tested in combination with cement.

Granting the truth of these three statements and the desirability of using a sand which meets the above requirements, how can the average contractor be convinced that a consideration of them should be of equal importance with what is usually the sole governing factor, namely, first cost of the job?

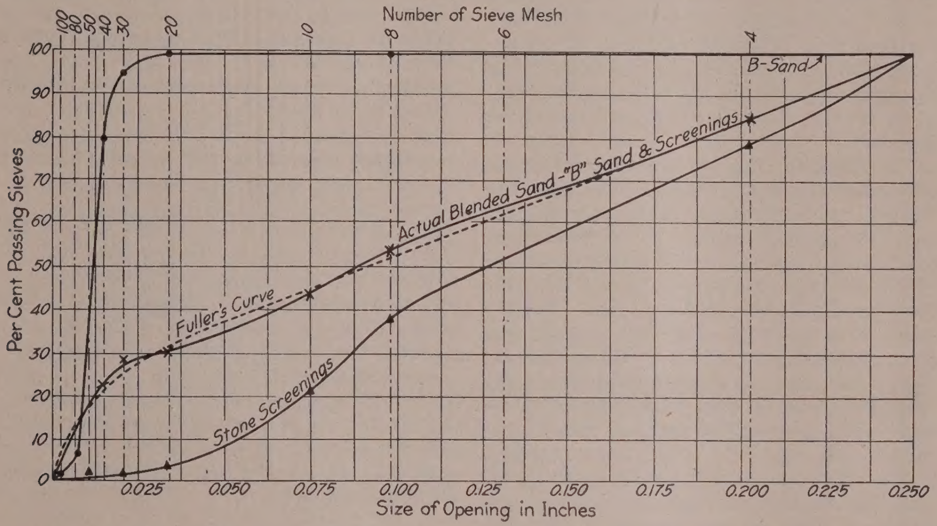


FIG. 2—BLEND SECURED FROM SAND AVAILABLE AND STONE SCREENINGS

Few contractors would knowingly use in a structure timber having a decayed heart, even though the outside, when painted, would look as good as sound material. Yet many of them now use unfit sand or dirty stone in a structure simply because they can cover it up and leave a job that looks first class. It may be safely assumed that if contractors realized and understood the importance of the quality of sand used in concrete and its bearing on the quality and durability of the resulting structure, they would take the necessary steps to secure proper material.

SAND TEST REPORTS

But suppose that a contractor proposes to use one of three available sands in an important job, and that to satisfy either himself, or the engineers or the architect or owner, he sends samples of the sands to one of the several commercial laboratories that carry out such tests. At the expiration of 28 days or so he receives a report such as that shown in Table 1.

To paraphrase the question of the cartoonist, "What is he gonna do with it?"

In all probability a copy of the report will be forwarded to the engineer, one of the materials will be accepted by him as meeting the specification requirements as to showing a tensile strength equal to 75 per cent of that of standard Ottawa sand briquettes made with the same cement under like conditions, the laboratory bill of $10 or so will be paid with a contemptuous grunt, and there the testing question will end. And in a little while, tons on tons of this "certified" sand will be used on the job in 1:2:4, or 1:3:6 or some other arbitrary proportions, and so far as anyone can see, except for the preliminary assurance that the sand would permit the cement to harden, the laboratory might as well never have had a hand in the question. Having done this, the contractor would have done all that many of those advanced engineers now do who think they test their sand for a concrete job.

SINGLE TEST INSUFFICIENT

But what of the concrete and its endurance? Were the tons on tons of sand used on the job identical with the 10-lb. or 20-lb. sample submitted to the laboratory? Or did they differ, and to what extent? If they were identical, what part has the testing had in the making of the concrete? The answer is that "you know and I know and we all know that you can't tell the difference . . . . when the sand is in the wall" unless something happens, and then the easiest way is to put the responsibility on the cement.

So far as the value of such testing of occasional isolated samples of material is concerned, there seems to be justification for the view of the contractor that it is of little or no value, save for the assurance that the sand will permit the cement to set. Nor does the fault lie with the testing laboratory. It has done its part, so far as authorized and permitted. As will be later demonstrated, sand tests to be of full value should be followed through on all shipments of material to the job. At present, however, there is no method of testing in common acceptance which will admit of this, save at a large expense for the equipment and maintenance of a field laboratory. For these reasons, no matter how conscientious the contractor, or how desirous he may be of exercising the most rigid inspection over materials, the sand goes into the work sanctified in bulk by one or by a few preliminary tests.

TABLE 1—REPORT ON SAND SAMPLES

Sample	Tensile strength, Pounds per square inch: 7 days	Tensile strength, Pounds per square inch: 28 days	Voids and Loam, Per cent: Voids	Voids and Loam, Per cent: Loam
A	217	305	32	4.1
B	167	271	33.4	3.3
C	121	208	36.6	2.2
Ottawa sand..	200	240		

Granularmetric Analysis

	Per cent passing sieve numbers											
Sieve numbers	2	4	6	10	20	30	40	60	70	100	140	200
Sample A.......	100	99	98	89	69	47	29	14	8	3.8	2.3	1.6
Sample B.......	100	99	98	96	87	72	56	31	17	5.8	2.6	1.6
Sample C.......	100	100	99	98	95	79	60	38	29	7.5	3.6	1.6

POSSIBILITIES FOR PROFIT

In this general disregard of tests there have been overlooked in many cases rich possibilities for profit through saving in cost of materials, because of lack of proper interpretation of the results.

It is too often the case that the results of sand tests are used only to determine which of two or more sands is the better, or whether or not a particular sand can be used, regardless of getting best results. Frequently, a proper application of the data obtained through a thorough series of tests of the materials available at a particular job would lead to a marked improvement in the quality of the sand used, either by adjusting proportions of fine and coarse aggregate, washing the sand, or mixing two or more sands to make a combination better than any one of the constituents. These things have been done in a large number of cases with such beneficial results that it should be easy to convince the average contractor that the opportunities are worth looking for.

In an article by one of the authors published in this journal Feb. 13, 1915, some of the principles of proportioning concrete were illustrated by actual examples, together with photographs of the internal arrangement of the different constituents for mixes of various proportions. It was found that the densest and strongest concrete was that in which the stone and sand had been graded according to Fuller's curve, and that the others made in arbitrary, or so-called "standard", proportions had strengths closely proportional to their relative densities and varying with the internal arrangement of their constituents. This was explained by a computation of the "burden" placed by these materials on the cement, both in covering surfaces and in filling voids; and it was endeavored therein to make evident the possibilities for saving opened up through the substitution, by proper grading, of a cheap and strong material, like sand, or stone, for costly and comparatively weak cement, with the added benefit of a great improvement both in the quality and in the strength of the concrete.

SAVING OF $13,280

The practical application of the same principles may be of great financial benefit to the contractor. One instance of this kind, where a saving of $13,280, with the production of a highly superior concrete, was made possible, is an example in point. The figures are actual, derived from careful tests, though exact locations and other details are, for obvious reasons, withheld.

This case occurred, let us say, in a Western State. A dam of considerable size was to be built, the total masonry construction being estimated at 60,000 cu. yd. Adjacent to the dam site was a stone quarry capable of supplying the large aggregate for the work, and open for lease, together with its machinery, at a fair rental. Sand beds were located at points varying in distance from 45 to 150 miles from the work. The specifications required, as usual, that sand should be "clean, sharp and coarse," should develop a tensile strength at 28 days in 1:3 mortar equal to 75 per cent of a like mortar of standard sand and should be acceptable to the engineer in charge.

MATERIAL SURVEY

A careful material survey revealed the following conditions:

By reason of their location, two sands only were of reasonable price. "A" sand would cost $2.24 per yard and "B" sand $1.92 per yard, f.o.b. job. Stone screenings cost $0.88 per yard. Considering "B" sand, since it was the cheaper of the two, in specified 1:2:4 proportions, would bring the sand cost to $57,600. Cement was furnished by the owner.

Examination in the laboratory gave the mechanical analysis shown in Table 2 of the two sands, and of the stone screenings from the crusher plant referred to.

TABLE 2—RESULTS OF ANALYSIS—PERCENTAGES PASSING VARIOUS SIEVES

Sieve number	Stone screenings	"A" sand	"B" sand
0.25 in.	98.1	97.1	100.0
4	78.1	91.2	99.9
8	38.6	81.0	99.8
10	22.0	75.9	99.7
14	9.6	67.2	99.5
20	3.2	54.4	99.0
30	1.5	38.4	95.9
40	1.2	29.7	79.0
60	1.0	19.7	5.5
80	0.0	16.1	0.9
100	0.0	12.6	0.4

As will be observed, the "A" sand had fair gradation, but its higher cost prompted closer consideration of the cheaper, though less ideal alternative. This "B" sand was of sizes lying mostly between the 40 and 60-mesh screens, with practically no gradation. Necessarily this latter sand would have a much less dense arrangement of particles in a given volume than would obtain if it contained both finer and coarser materials.

A search for these lacking fines and coarses brought about an examination of the crusher screenings from the quarry. The mechanical analysis of this by-product (See Table 2) showed it to have the desired coarse particles, but to be deficient in particles of those sizes which the natural sand could supply. Combining these two materials, therefore, with Fuller's curve as a reference and guide, gave the approximation shown in the diagram on page 735.

CALCULATION OF DESIRED ADDITIONS

This approximation, it should be understood, is obtained by separately plotting the curves of the "B" sand and of the crusher screenings as obtained from the analysis of each material. Fuller's curve, which is a combination of ellipse and straight line, is plotted with points obtained from an equation for which William B. Fuller is authority (See Taylor & Thompson's "Concrete, Plain & Reinforced", page 206). This curve is taken as the ideal which it is desired to approach by a combination of materials—in this particular case, the "B" sand and stone screenings.

TABLE 3—COMBINED ANALYSIS BY FULLER'S CURVE—PERCENTAGES PASSING DIFFERENT SIEVES

Sieve		Stone × Factor		"B" Sand × Factor	Sum of Blend, Calculated
0.25 in.	0.72 ×	98.1 = 70.5	0.28 ×	100.0 = 28.0	98.5
4		78.1 = 56.4		99.9 = 28	84.4
8		38.6 = 27.8		99.8 = 28	55.8
10		22.0 = 15.85		99.7 = 28	43.85
14		9.6 = 6.82		99.5 = 28	34.82
20		3.2 = 2.30		99.0 = 27.7	30.00
30		1.5 = 1.08		95.9 = 26.8	27.88
40		1.2 = 0.86		79.0 = 22.18	23.04
60		1.0 = 0.72		5.5 = 1.54	2.26
80		0.0 = 0.0		0.9 = 0.025	0.025
100		0.0 = 0.0		0.4 = 0.011	0.011

It is evident that the percentages of either material passing any given sieve can be read for all three curves on any intersecting ordinate. It is evident, also, that on such an ordinate, the percentages desirable to pass any given sieve can be determined from its intersection with Fuller's curve. Subtracting actual and ideal percentages then gives the variation of the actual materials, from the ideal; and knowing this difference, the proportions of one needed to supply the lack of the other may be determined.

For instance, the No. 30 sieve ordinate cuts the screenings curve at 1.5 per cent; the Fuller's curve at 25 per cent; and the "B" sand curve at 95.9 per cent. The screenings curve then differs from Fuller's curve by (95.9—25.0) = 70.9 per cent; and the "B" sand curve differs by (25.0—1.5) = 23.5 per cent. In order, then, to get the percentages of each material necessary to secure an ideal blend, each of these differences is divided by their sum, or 94.4. Hence 70.9/94.4 = 75.1 per cent screenings will be required; and, 23.5/94.4 = 24.9 per cent sand, or 3 parts of screenings and one part sand.

In like manner, various percentages are determined for other ordinates on the diagram, and the average of these percentages is taken as that best suited to give a blend most closely approximating Fuller's curve. From averaging with the two materials under consideration, the ratio of 5/7, or 72 per cent of stone screenings to 2/7, or 28 per cent of "B" sand, was determined. In Table 3, columns 2 and 3, will be found the mechanical analysis of the sand and screenings as given in Table 2, multiplied by their respective factors.

In column 4 are given the percentages obtained for the blend by adding these derived percentages. The curve, Fig. 2, plotted from the actual screen analysis of the mixed sand produced by theoretical blending gives a very close approximation to the ideal curve—far better, certainly, than either of the individual materials alone. A slightly higher percentage of fines is shown, probably due to the inclusion in the actual blend of a pocket of crusher dust, which was lacking in the first screenings analyzed.

So far as this procedure has gone, it has offered a blended material which should, if previous statements are correct, show a higher strength when mixed with cement than the natural materials which do not follow Fuller's curve. To determine the correctness or incorrectness of this, comparative test specimens, both of 1:3 mortars and 1:2:4 concretes, were made under uniform conditions with blended and unblended sands, with the results shown in Table 4. These results confirm the correctness of the early assumptions made. It should be noted that not only are the strengths of the mortars and concrete made from the blended materials in great excess over those made from "B" sand alone, but further, that while the blended sand requires, under laboratory conditions, but 10 per cent of water for normal consistency, the "B" sand requires 12 per cent, an excess of 2 per cent under the best conditions, which will be greatly exaggerated under field conditions, with further detriment to the concrete. It is evident, also, that "B" sand, although apparently of good quality so far as appearance goes, is unfitted for use alone. The quality and strength of concrete that would have been produced if this sand had been used without being tested needs no comment.

TABLE 4—TESTS OF MORTARS AND CONCRETES WITH BLENDED AND UNBLENDED SANDS, TO CHECK CONCLUSIONS DRAWN FROM SAND ANALYSIS

1:3 *Mortars*

"B" sand 12% water		Blended sand 10% water		Standard Ottawa sand 10% water	
Strength, 8 days.		Strength, 8 days.		Strength, 7 days.	
Tension	Compression	Tension	Compression	Tension	Compression
31	167	309	1777	182	900
—	194	352	1805	195	778
100	122	315	1944	195	944
Av. = 65	161	Av. = 325	1842	Av. = 191	874

1:2:4 *Concretes*

	"B" Sand	Blended Sand
7 days	390 lb./sq. in.	1055 lb./sq. in.

COMPUTATION OF SAVING

Evidently, then, from the standpoint of securing strength alone, if from no other, it is highly desirable to use the blended materials. The question of relative costs is now of paramount importance. Despite the usual supposition that nothing could be cheaper than dumping a natural sand direct from cars to mixer, an estimate of the relative costs of natural and blended materials revealed the following:

The 60,000 yd. of 1:2:4 concrete will require 30,000 cu. yd. of sand. At $1.92 per yard, the sand would cost $57,600. By laboratory tests five-sevenths of the "B" sand can be advantageously replaced by stone screenings. Therefore: 5/7 × $57,600.00 = $41,200, the value of the sand replaced by stone screenings. The stone screenings will be 5/7 × 30,000 = 21,500 yd. and will have a value of 21,500 × $0.88 = $18,920.00.

Therefore, $41,200.00 — $18,920.00 = $22,280.00 saving on material.

Assuming cost of blending as 3 cents per yard of sand, the total extra cost for blending would be 30,000 × 0.03 = $9,000.00. Therefore, $22,280 — $9,000 = $13,280 is the net saving by using blended sand.

BETTER CONCRETE AT A SAVING

It is evident, then, that in the question of sands, the contractor is confronted by a condition that is not wholly a theory. A saving of $13,280 on a job is not to be sneezed at by most contractors, unless they are altruists, and few contractors who remain in business possess that lamentable virtue. Yet, in following the procedure outlined above, the contractor has thereby become an altruist, in addition to being a good business man, for he has not only lined his own pocket, but has benefited his employer, the owner, by giving him a superior concrete. Nor is this improvement in quality and saving in cost only possible of accomplishment by attention to the sand. Grading the large aggregate offers further beneficial possibilities, although these will not be here considered, since these articles deal specifically with the question of sands, as generally the more important of the two materials.

But since these advantages do accrue through testing of sands, why is it not carried on more extensively? The answer lies, first, in the lack of appreciation of its necessity, or its possible value, as before noted; and second, in the inherent difficulty of carrying out such tests without an elaborate organization and expensive equipment. A review and discussion of the various customary methods at present in vogue, together with some special qualities of sands and indications for improved procedure, will form the subject of the next articles.

Production of Structural Shapes in 1914 Fell Far Below 1913

THE PRODUCTION of iron and steel structural shapes in the United States in 1914, according to Special Statistical Bulletin 3—1915 of the American Iron and Steel Institute, was less than in any previous year since 1908, with the exception of 1911, when small structural forms were not included, and the figure given was slightly lower. The figures for 1914 and 1913 were 2,031,124 and 3,004,972 gross tons respectively. As the exports amount to approximately 10 per cent of the total production (falling from 403,264 gross tons in 1913 to 182,395 in 1914) and the imports are less than 1 per cent of the output, the total consumption was somewhat less in each case than the production. The decrease in consumption was 754,493 gross tons, or 28.8 per cent. More than 99 per cent of the production was steel.

Rio's Asphalt Plant Attractive

IT IS HARD to realize that the photographs reproduced herewith show an asphalt plant. In American cities plants of this description are usually eye-sores. Rio de Janeiro has proved, however, that this need not be the case. The plant site is surrounded by a panel stucco wall. Not an unsightly feature is visible. Even the elevator, it will be noticed, has been latticed in. Inside the plant there is the same cleanliness and orderliness that is noted without. Sand and stone is kept entirely under cover, as shown in the view of the material shed, a measure of efficiency as well as attractiveness.

The Rio plant was designed and supplied by the Iroquois Works of the Barber Asphalt Paving Company and erected under the supervision of W. T. Bamford, who is now in charge for the municipality of Rio. It has a capacity of about 1500 yd. a day.

Air Analyzer Determines Fineness of Fine Cement

J. C. Pearson and W. H. Sligh Report Method Developed After Experiments at U. S. Bureau of Standards

THE INCREASING demand for more finely ground Portland cement has necessitated a further investigation of the value of fineness, particularly from an economic standpoint. An adequate investigation of this kind can be undertaken only when some further method of separating the "fines" from the No. 200 sieve is available, and therefore a number of attempts have been made in recent years to develop an elutriator for this purpose. After a series of preliminary experiments, an air analyzer has been developed at the U. S. Bureau of Standards which seems to meet the fundamental requirements and give reliable separations of cement and certain other materials.

The distinguishing features of the apparatus are: The introduction of an unretarded air stream into a conical bulb in such manner that the sample under examination is completely and continuously exposed to the action of the air; a separating chamber of considerable height which permits no lodgment of either fine or coarse particles; a tapping device to minimize the adherence of fine dust to any part of the apparatus, and a collector which catches and holds all material passing through the separating chamber.

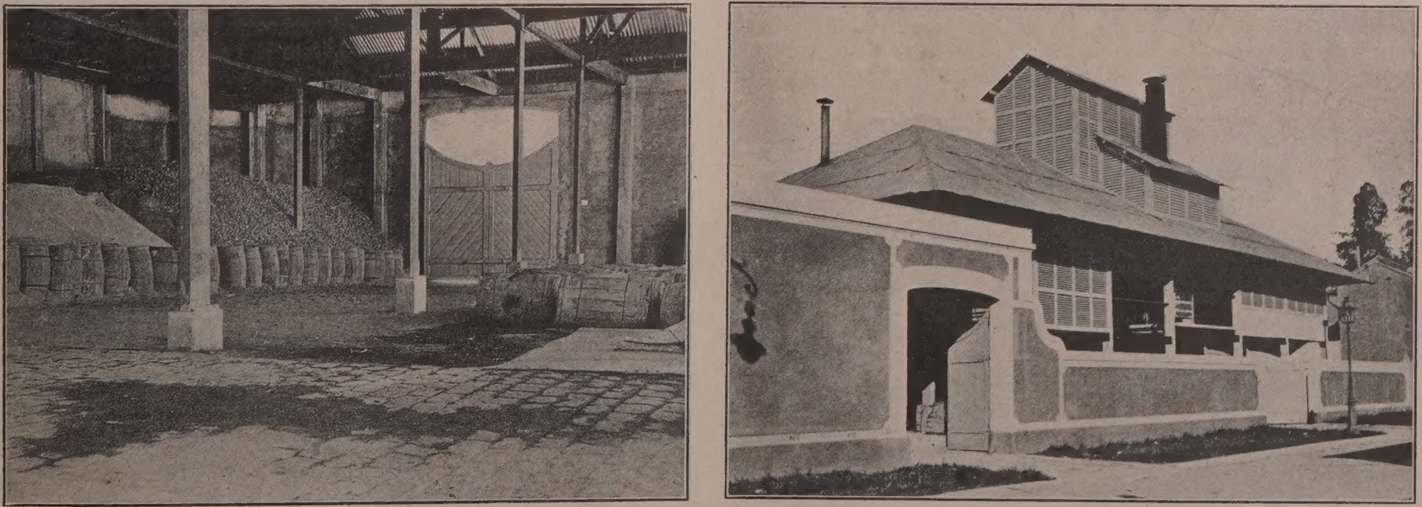
The main objection to elutriation methods appears to have been the lack of standardization of apparatus heretofore used. An endeavor has therefore been made to define the separations obtained by the air analyzer in terms of the limiting sizes of particles in the different fractions. These limiting sizes, designated as the "sizes of separation," may be interpreted in different ways, depending on the methods of measurement. Several of these methods have been studied, and a system has been provisionally adopted which appears to be the simplest and most direct, although not giving directly the "true diameters" of the particles under examination. The relation between the "apparent" and the "true" sizes of particles has been expressed by means of reduction factors.

ATTAINABLE ACCURACY

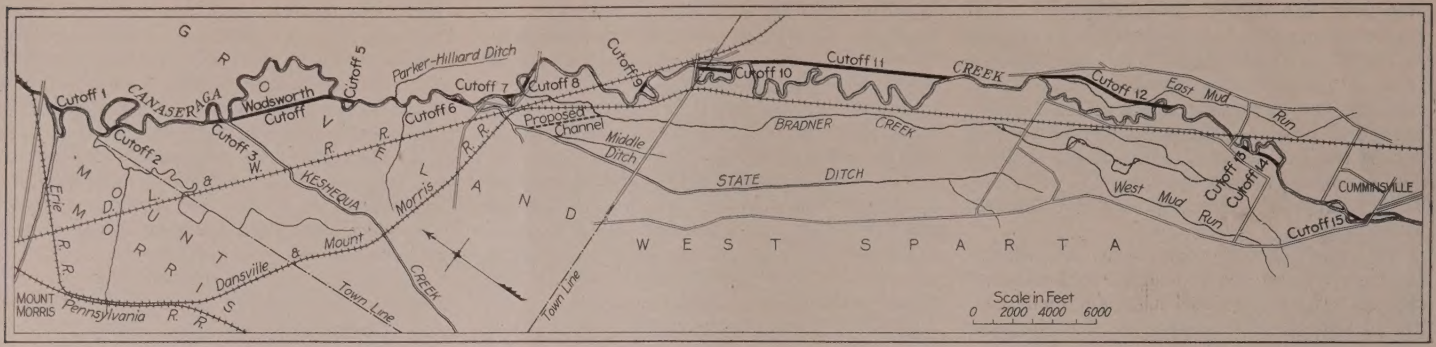
It seems probable that under normal operating conditions the nominal sizes of separation of the analyzer determined by calibrations with normal cements will be within about 5 per cent of the actual sizes. This gives rise to a possible error of about 1½ per cent in estimating the quantity of any desired fraction from the mechanical analysis curve. As the error in determining the percentage of any given fraction by actual separation in the analyzer is probably not greater than 0.5 per cent, it may be assumed that routine analysis, without special calibrations, will enable one to determine the quantity of particles below a given size in any normal cement within 2 per cent.

The analyzer has been developed with the particular purpose in view of determining the granulometric composition of very finely ground and air-separated cements, to be used in a further investigation of the value of fine grinding, which is now under way. It is also adapted in its present form to comparisons of the different finishing mills, and to the separation and grading of abrasives and other hard-grained materials. In view of the considerable variety of finely divided materials already tested with the analyzer, the apparatus promises to have a much broader field of usefulness than that for which it was originally designed.

A POCKET MAP OF WATER MAINS for constant reference is furnished the foreman of the San Diego waterworks. The valve and hydrant books of small size did not answer the purpose on account of the many changes from month to month, so it was decided to make a pocket edition of seventy-five sheets of the distributing system with a key map showing upon what sheet certain sections could be found. The plots show streets, blocks, alleys, location of valves and hydrants and size of mains.



THE ASPHALT PLANT AT RIO DE JANEIRO IS CHARACTERIZED BY AN ORDERLY INTERIOR AND AN ATTRACTIVE EXTERIOR



STRAIGHTENING AND ENLARGING CHANNEL OF CANASERAGA CREEK RECLAIMS WIDE TRACT OF FERTILE LAND

River Improvement for Public Health Reclaims 10,000 Acres of Fertile Land

First Improvement Carried Out by New York State Under Article 7 of Conservation Law Protects Lands That Lease For from $20 to $30 per Acre

By R. W. SHERMAN
Chief Engineer, New York State Conservation Commission

IMPROVEMENTS in the valley of Canaseraga Creek in western New York from its mouth to a point 15 miles upstream have effected the reclamation of 10,000 acres of fertile land, at a cost which will not exceed $20 per acre. This is the first improvement work of the kind carried out by the State under the Conservation Law, and was initiated under Article 7, which authorizes such improvement for the protection of public health and safety.

DRAINAGE AREA 347 SQUARE MILES

Canaseraga Creek has a drainage area of 347 square miles, and empties into the Genesee River at Mount Morris. The territory benefited by the improvement is that part of the valley and flats lying between the Genesee River at Mount Morris and Cumminsville. The improvement district is bounded by the maximum high-water flow line between the points stated and comprises about 10,000 acres. This area is particularly rich fertile land, fully one-half of which is admirably adapted to the raising of tree nursery stock, while a large part of it (especially the muck lands) when properly protected from floods and incidentally drained by the improvement, is well adapted to the raising of celery, onions, beans and vegetables generally, and other portions to the raising of corn and potatoes. A large part of this fertile area has been abandoned and has grown up to weeds, brush, wild grass and cat-tails, for the reason that while prolific and valuable crops could be raised thereon, they were subject to destruction by flood overflows, an average of one crop out of three being thus destroyed, and the heavy losses made it unprofitable to keep the land under cultivation.

TOTAL EXCAVATION 800,000 CUBIC YARDS

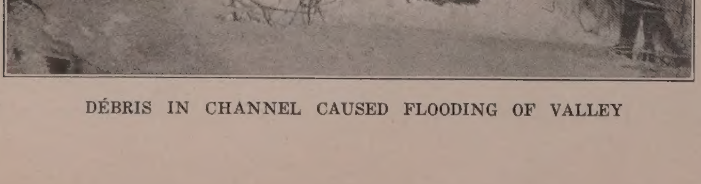
The work, by far the greater part of which has been done, consists of deepening, widening and cleaning out the existing channel from its mouth to Cumminsville or Dansville, and the excavation of several miles of entirely new channel for cutting off bends, thereby straightening and shortening the natural channel. The improved channel has a bottom width of 50 ft. in its lower section, which is reduced from point to point upstream to a 26-ft. width at Cumminsville, with slopes of 1:1 throughout and 10-ft. berms between the top of the slopes and the spoil banks. The gradient of the improved channel is 0.4 ft. per 1000 ft. in the lower stretches, increasing to 0.85 and in the upper 2 miles to 3 ft. per 1000 ft. From Groveland to Cumminsville, a distance of 9 miles, there is a continuous dike on the westerly side of the channel made principally from material excavated from the channel. This dike has so far wholly prevented flood overflows from the channel to the westward. There are a number of farm and highway steel bridges varying in span from 60 to 80 ft. supported on concrete abutments with pile foundations.

In addition to the 15 miles of Canaseraga Creek improvement channel there are approximately 20 miles of newly excavated branch channels, partly on the location of natural channels, but very largely in new locations, such as cutoffs. The bottom width of the branch channels varies from 30 ft. down to 8 ft., with 1:1 slopes, the material being deposited in spoil banks, sometimes on one side, but usually on both sides, with sufficient berms. The total quantity of excavation in all of the channels is about 800,000 cu. yd.

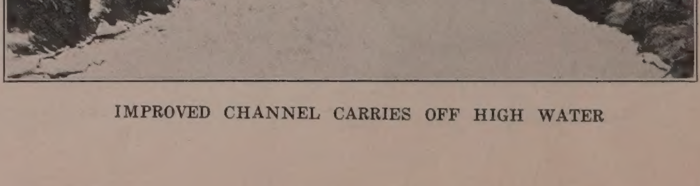
CONTRACTORS ABANDONED WORK

The intention was to have all of the work done by contract, but the contractors to whom it was awarded abandoned it when it was still far from completion. The work in the Canaseraga Creek channel and the principal branch channels up to this time had been done with floating dipper dredges, the larger of which had a scow with a deck 40 x 100 ft., an A-frame, 75-ft. boom and 2-yd. dipper. The other dredge, with a 1½-yd. dipper was new, and had a steel scow and A-frame. This dredge was equipped with bank spuds, which proved to be very advantageous as compared with the vertical spuds on the larger dredge, as great difficulty resulted from the sinking of the vertical spuds, while the bank spuds held the scow securely in position.

In completing the work after abandonment by the contractors the commission did not make use of the floating dredges, but continued the work on the larger channels with a Browning drag-line excavating machine with a 75-ft. boom and 1½-yd. bucket. About 3 miles of the smaller channels, with bottom widths of from 8 to 10 ft. and depths of from 4 to 6 ft. were excavated by Keystone excavators or small steam shovels with ½-yd. back-action dippers, the steam shovels working on the natural surface of the ground and moving backward from the end of the excavated ditch, with the dipper excavating toward the machine instead of from it, contrary to the ordinary practice of steam shovels. These little ma-



DÉBRIS IN CHANNEL CAUSED FLOODING OF VALLEY



IMPROVED CHANNEL CARRIES OFF HIGH WATER

DREDGE USED BY CONTRACTOR

chines proved very satisfactory, doing good and economical work. The drag-line excavating machine had the advantage of laying the excavated material well back in spoil banks with wide berms, which the large dredge abandoned by the contractors could not accomplish where the bottom width was 50 ft. and the cut 10 ft. or more.

COST AND BENEFITS

Bonds to the extent of $200,000, at 5 per cent, based on the credit of the improvement district, were issued and sold at a premium. The proceeds will complete the improvement and leave some surplus. The cost will not exceed $20 per acre, exclusive of interest on the bonds.

A line drawn east and west across the valley, not far northward from Groveland, a station on the Delaware, Lackawanna & Western Railroad, would divide the improvement district into approximately two equal parts. On the southerly or upper portion, consisting of about 5000 acres, the improvement is completed, and has resulted in the prevention of any flood overflows; the flood waters are being confined to the new Canaseraga Creek channel and its branches. Lands suitable for tree-nursery stock lease at from $20 to $30 per acre, and in this portion of the territory land never used for this purpose heretofore has already been planted with nursery stock, while other portions not heretofore under cultivation for very many years have been reclaimed and planted to beans and corn. The improvement on this part of the territory has accomplished all that was expected of it, and more, and has proved very satisfactory, with greatly enhanced real-estate values.

The territory in the lower or northerly half of the improvement is overflowed in very high floods by back water from the Genesee River, and this feature will continue indefinitely. These floods, however, usually occur in the late winter or early spring, and very rarely in the crop-growing seasons. The new channels in this part of the district will result in lowering the maximum flood elevation by a few feet, and will cause the duration of submergence to be greatly shortened by reason of the more rapid runoff of the waters as the floods subside.

LITIGATION

An action was brought by a property owner contesting the constitutionality of the river improvement law. The courts held the law to be constitutional. Another action was brought covering numerous legal points; among them, that it was a drainage scheme, not a river-improvement scheme, and could not be carried out under the river-improvement law, but should be done, if at all, under one of the drainage laws. It was also contended that the real object was not the conservation of the public health, but drainage and the increasing of property values. The New York Court of Appeals held that it was not a drainage scheme, but a river improvement scheme; that its object and purpose was the conservation of the public health and that while some drainage might be inevitable, together with increased productiveness of the lands and enhanced property values, all such benefits were inevitably incidental to the real purpose, viz., conservation of the public health. This decision carries with it the right to take private property for the purposes of the improvement by condemnation; this right being clearly inseparably associated with the real object, namely, conservation of the public health.

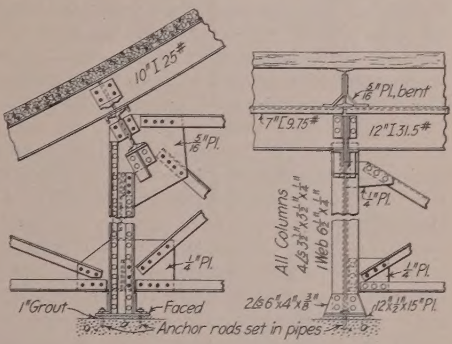
The same public-health features would govern in drainage schemes, either under Article 8, "Drainage," of the conservation law or under Chapter 65, "Drainage," of the Consolidated Laws.

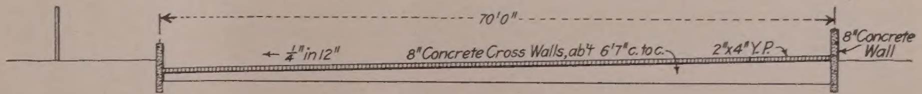
Sheepshead Bay Two-Mile Speedway Scientifically Designed for High Velocities

Steel I-Beams and Concrete Walls Shaped to Parabolic Curves on the Turns Support Timber Flooring in New York's Automobile Race Track

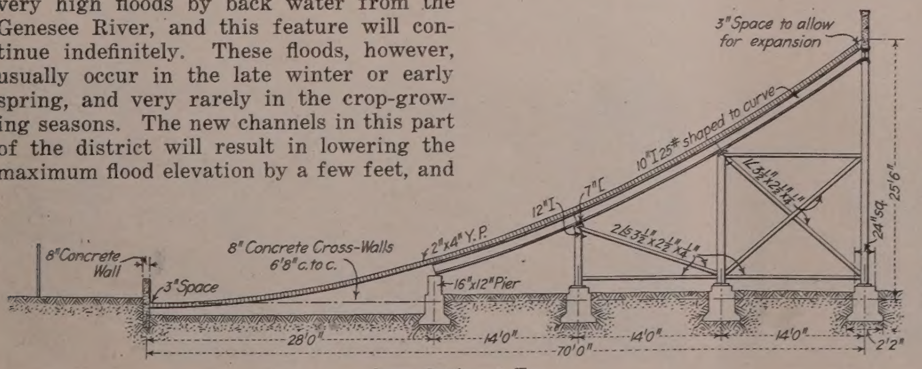
CONSIDERATION of the maximum allowable speeds on the turns at the new Sheepshead Bay speedway in New York City resulted in the adoption of a curved track surface always normal to the resultant loads at the assumed speeds. The parabolic curves provide for speeds of the racing automobiles varying from 40 miles per hour at the lower inside to 96 at the outer top of the turns, and permit a speed of at least 120 miles per hour when frictional resistance is considered. Curved I-beams bent cold to exact shape and concrete walls finished to a curved top surface by the use of thin bent strips nailed to the forms support the 2 x 4-in. timber flooring. A gradual transition from the 1800-ft. straightaway to the circular end turns of 853-ft. radius was attained by the use of 3 1/3 per cent grades with 120-ft. vertical curves at each end. The resulting horizontal compound curves and the elevations were carefully computed and fixed in the field by level and transit.

The new track is to form part of a huge sport-arena development by the Sheepshead Bay Speedway Corporation at Sheepshead Bay, New York, and designed to provide ultimately for about 100,000 spectators in its large grandstand and bleachers. The space inside the 2-mile oval track, about 1400 x 1800 ft., furnishes parking accommodations for about 10,000 automobiles, and will also be utilized for baseball, football and track-athletic fields. Provision is made for three tunnel passages for automobile entrance to the inner field. The floors and side walls of these tunnels are waterproofed and reinforced against hydraulic pressure, as the floor is 6 ft. below high tide. The estimated quantities are 12,000 cu. yd. of concrete, 1570 tons of steel, and 3,000,000 ft. b.m. of lumber in the track construction. The grandstand and the bleachers, the con-

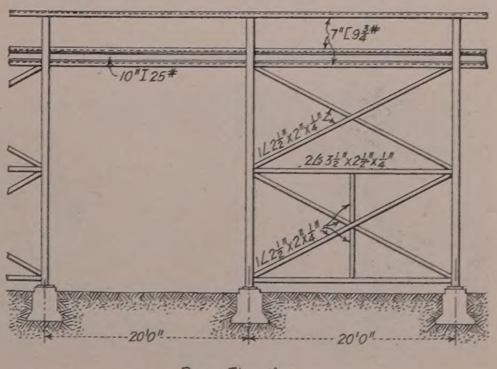




Cross-Section at Straightaway



Cross-Section at Turn



Rear Elevation

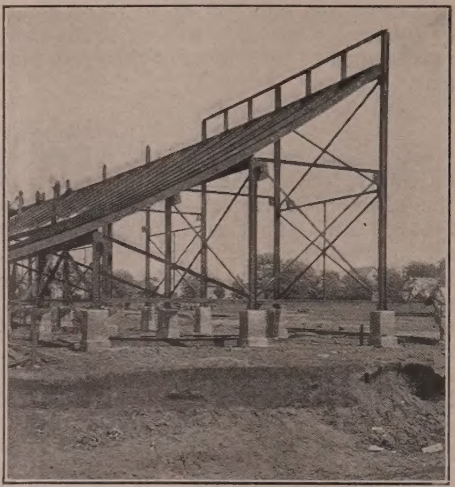
CROSS-SECTIONS, ELEVATION AND TYPICAL DETAILS OF STEEL-TOWER CONSTRUCTION ON THE TURNS struction of which has not yet been started, will require about 2500 tons of steel and about 3,500,000 ft. of timber.

Loads and Flooring Details

The typical construction adopted for the straightaway portions and the banked turns is shown by the cross-sections herewith. The concrete cross walls on the straightaways and the curved I-beams on the turns are spaced 6 ft. 8 in. apart. The 2 x 4-in. yellow-pine flooring set on edge simply rests on these supports without clips and is dressed to a true top surface, to which a light commercial creosote oil (spec. grav. 1.04) will be applied with mops. Reinforced-concrete slab construction was estimated, but found higher because of added cost of forms and slabs on the banked turns, and the extra steel.

The racing cars were assumed to weigh 3000 lb. each with wheel loads at 5-ft. gage and 10-ft. spacing, and one wheel load was assumed to be carried by three planks, as these planks are spiked together on 2-ft. centers, staggered. The timber joints are also staggered about 2 ft. The contract requires the use of 16 per cent of 14-ft., 16 per cent of 16-ft., 18 per cent of 18-ft., and 50 per cent of 20-ft. lengths. To allow for expansion of the flooring due to moisture, 3 in. clearances inside and outside, as shown on the drawings, were provided. The space under the track is ventilated by square openings in the 8-in. concrete walls, shown inside and outside of the track. Drainage is provided by 8-in. porous tile 2 ft. inside the inner walls, except where sandy soil is found.

The design of the transition section between the 1800-ft. straightaways and the end turns was worked out in detail, using the grades and vertical curves, as shown, in order to avoid any sudden break in the track surface. The change from concrete walls to steel frame construction was made as soon as the outside ends of the 8-in. cross walls reached a height of about 6 ft. above the final graded level of the ground surface. The construction at this section is indicated in one of the accompanying photographs, which shows the piers and walls in place to receive the steel columns and beams. At the particular point here shown, the walls are 9 or 10 ft. above the original ground level. A second photograph shows the forms for a cross wall to be added to stiffen these high walls laterally. In general the 8-in. walls were carried down 2 ft. below the ground surface, or to solid bearing. The outside walls and wing walls were carried down below the frost line.



CURVED I-BEAMS SUPPORTED BY STEEL TOWERS ON TURNS

Steel Construction on Turns

In addition to the dead-load weight of the flooring, the beams and columns in the typical viaduct type of steel construction used at the turns were designed to resist the centrifugal force and vertical weight of the racing cars, assuming four cars abreast on the turns, and 100 per cent impact. The minimum sections allowable for ¾-in. rivets and field bolts were used for the longitudinal bracing, the stresses being very low because every other 20-ft. bay was braced. The unit stresses allowed by the New York building law and the American Steel Manufacturers' standard specifications for the steelwork were used.

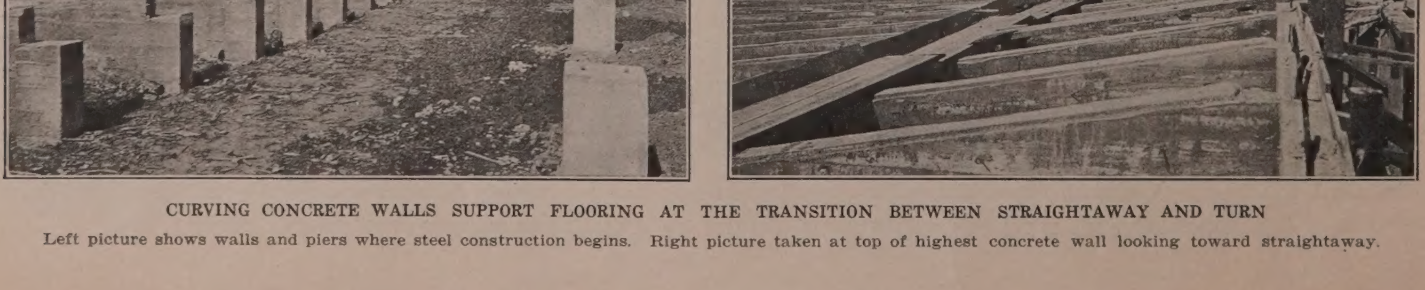
One of the photographs shows the bent I-beams and steel-tower construction. These 10-in. beams, bent cold, were found more economical than either timber blocks beveled to curve form supported on straight 8-in. I-beams, or built I-sections curved to shape. The 10-in. beams were tested after bending to determine their strength and elasticity. A load of 14,000 lb. uniformly distributed on the total span of nearly 17 ft. caused a deflection of only ¼ in., which disappeared upon the removal of the load. This construction was, therefore, adopted. To resist any lateral components the longitudinal beam supports were designed of I-beams and channel type as shown. Details of the connections are indicated in one of the accompanying drawings.

The centrifugal force and required superelevation on the turns were computed by well-known formulas. The maximum outside elevation of about 25 ft. was adopted for the 70-ft. width of track for economy, after several estimates for other heights and widths had been made. As the speed formula is that of a parabola, the track surface was built to follow a parabolic curve on the turns. The resulting allowable speeds are 40, 52½, 65, 77½ and 96 miles per hour on each of the 14-ft. sections from inside toward outside of track, to give normal resultant pressure on the track.

The work is rapidly progressing, with about 1250 men employed in order to complete the track and two-thirds of the 1800-ft. grandstand before the first race meet early in October. The materials for the concrete are hauled about 3½ miles to the site from the barge landing at Coney Island. Concrete of 1:5 Portland cement with broken stone and screenings is used on most of the work, but sand from the site has replaced the screenings when the latter were not available. The concrete is mixed by Lansing mixers and placed by wheelbarrows run on plank walks, the usual wooden forms being used. The piers and walls will be supported on piles at the east turn where swampy ground is encountered.

The design and methods of construction have been worked out by Blaine H. Miller, chief engineer, and H. B. Thorn and C. F. Gardiner, assistant engineers for the Sheepshead Bay Speedway Corporation, of which Everard P. Thompson is manager and vice-president. The general contractors are the Coast & Lakes Contracting Corporation, of New York, under the personal supervision of E. F. Gray, and the steelwork is furnished by the Lackawanna Bridge Company, of Buffalo.

A Telegraph Time-Zone Map has been issued by the Western Union Telegraph Company for the general good of the service. It enables the receivers of messages to determine the standard time used at points from which messages are sent and thereby correct misapprehension, should there be any, over questions of dispatch in the service. Cleveland, by its own decision last year, appears in the Eastern time section.



CURVING CONCRETE WALLS SUPPORT FLOORING AT THE TRANSITION BETWEEN STRAIGHTAWAY AND TURN

Left picture shows walls and piers where steel construction begins. Right picture taken at top of highest concrete wall looking toward straightaway.

THREE CONCRETE RINGS, SUPERIMPOSED AS SINKING PROGRESSED, FORM THE PUMP PIT

Concrete Rings, Superimposed, Sunk to Form San Antonio Pump Pit

Water Supply Company's New High-Duty Turbine-Driven Centrifugal Units Are Direct-Connected to the Service Mains

By WILLIAM WREN HAY
Fort Sam Houston, Texas

THE San Antonio (Texas) Water Supply Company, has nearly completed a new pumping station, which embodies two unusual features of design—one, the sinking of a very large diameter concrete caisson for the pump pit; the other, the connection of high-duty centrifugal pumps direct to service mains. The water supply of the district is pumped from artesian wells, and the new station is an addition to the company's operating stations. The fluctuations of the hydrostatic head throughout the district have been definitely established by the company, and as there is always the possibility of competition, it was determined to lower the axes of the new pumps so that positive control of the ground water supply in the vicinity of San Antonio might be retained at all times.

The new station is situated in a water reserve within a public park comprising some 52 acres, and consists essentially of two high-duty centrifugal pumps, pumping from two 12-in. artesian wells about 800 ft. deep, together with new pipe lines, connecting and control valves, and two 20-in. Venturi meters. The new pump pit is sunk to a depth of 45 ft. below the surrounding ground level, in a bowl-shaped depression provided with a catch-basin for removing surface water and seepage.

PUMP PIT OF CONCRETE RINGS

The pump pit consists essentially of three reinforced-concrete rings, 11 ft. 9 in. in height, superimposed one upon the other and having an outside diameter of 54 ft. The caisson thus formed was sunk into the earth by removing the materials from the interior and allowing the rings to lower as excavation advanced. The rings are in general 24 in. thick, the bottom ring being battered inside for a footing course. The top ring is finished with a wide coping upon which is built the brick wall for the lantern roof. The joint between the rings is made by a 6 x 3/8-in. circumferential steel hoop to which are bolted small vertical angles to serve as templates for the circles, and to which the horizontal reinforcing steel is wired.

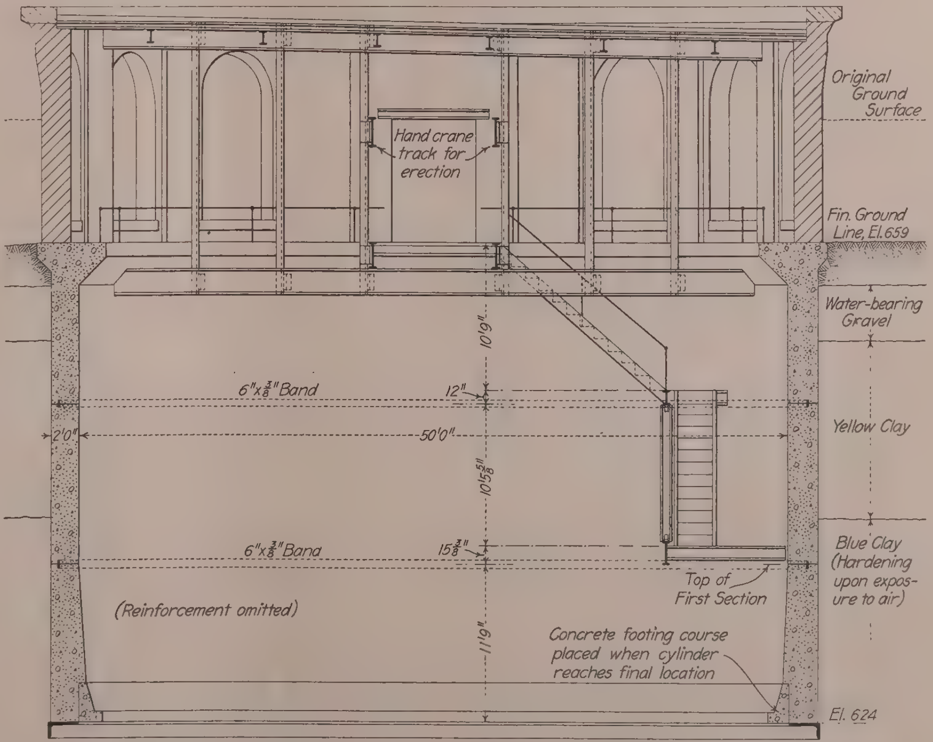
The rings are reinforced with square twisted rods, placed horizontally for exterior pressures, and vertically for secondary stresses. The whole rests upon a cast-iron shoe, shaped as a cutting edge. The first section was reinforced at the bottom to take any bending moments that might develop due to support at two or three points as the ring was dropping, and after the first section had been sunk it was determined to add additional steel as a further safeguard. A section 36-in. in height was concreted on top of the first section, and the concrete allowed to set for two weeks before continuing the operation of sinking, thus forming a deeper ring with additional steel in the top. The same amount of steel was added to the original design at the top of the second section.

No trouble developed during normal sinking, but as the final clay was removed to a depth of several feet below the edge before sinking, the ring dropped about 3 ft., breaking off a short piece of the cast-iron ring and wedging it behind the concrete. The clay, after exposure to the air, was then so hard that the wedging was sufficient to cause a crack to appear in the ring for a height of about 5 ft. above the bottom. The piece was loosened and the crack was closed up. The foundations for the pumps are placed inside the concrete ring, and the whole is covered over with a brick, concrete, and steel lantern.

In addition to the pump-house structure, there are two concrete well casings sunk in the same manner as the pump pit, allowing inspection of well casings and control valves. These casings have inside diameters of 8 ft., with 12-in. reinforced-concrete walls, and consist of three segments, 13 ft. high.

MECHANICAL EQUIPMENT

The main pumping equipment consists of two high-lift, 6,500,000-gal. series-parallel centrifugal pumps and steam turbines, with two surface condensers and condenser equipment. The normal operation will be in series against a head of 273 ft., and, in the event of fire, against a head of 343 ft. Operating in parallel each pump is to deliver 10,000,000 gal. against a head of 175 ft. Water will come to the



JOINTS BETWEEN CAISSON RINGS ARE MADE BY CIRCUMFERENTIAL STEEL HOOPS pumps under a head of from 5 to 50 ft., but they are designed to operate under suction. The pumps are to operate in a direct system of water distribution, under a continuous variable load, and are equipped with special governing devices. Two low-lift centrifugal pumps with steam turbines are to be installed for irregular operation. One of these will have a rated capacity of 2000 gal. per minute against a head of 25 ft., pumping storm-water from a catch basin; the other will be used for pumping seepage from the sump pit inside the pump house, and will have a rated capacity of 200 gal. per minute against a head of 65 ft. Both of these small units are to operate non-condensing. The pumping units and equipment are being furnished by the De Laval Steam Turbine Company.

Three Babcock & Wilcox water-tube boilers are installed, each having a rating of 250 boiler horsepower, with shaker grates of a type for handling Texas lignite, and arranged in one and one-half batteries. The boilers are equipped also with oil burners, as it will be to the company's advantage to burn fuel oil for at least two years. Two feed-water pumps and two oil pumps are installed for the two batteries.

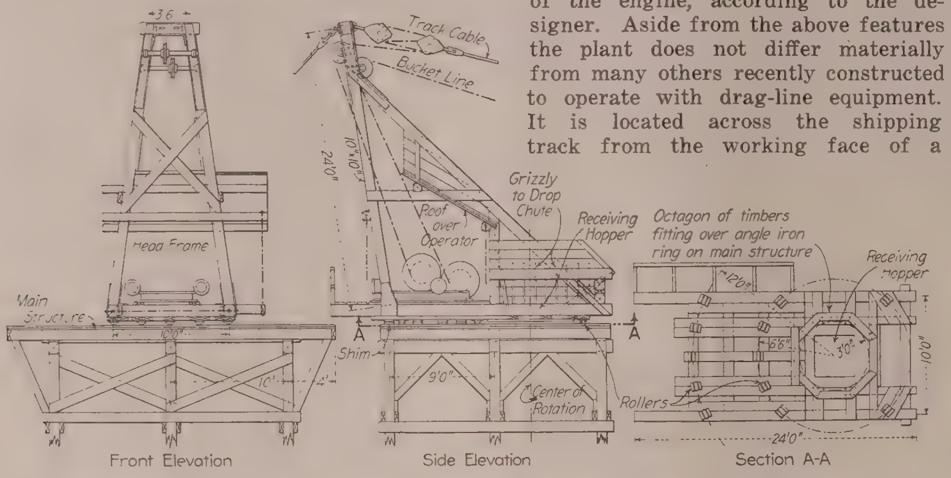
The pumps are to be tested when running in series against a head of 273 ft., for a duty of 107,000,000 ft.-lb. when running in series against a head of 343 ft., and in parallel against a head of 175 ft., for a duty of 112,000,000 ft.-lb. The pumps are to develop these duties on the basis of 1000 lb. of steam at 150 lb. per square inch pressure, the amount of steam required to operate the condenser pump to be charged against the pump unit. The amount of steam will be determined by weighing the feed water, leakage from the boilers being first determined and deducted. The delivery of the feed water will be measured by Venturi meters.

The entire design of the pumping station was made for the San Antonio Waterworks Company by Robert J. Harding, vice-president and general manager, and construction work has been under his personal direction. The H. N. Jones Construction Company, of San Antonio, was the general contractor for the construction; C. F. Young was general superintendent. The cost of the new plant will be about $250,000. There were about 3000 cu. yd. of excavation and 435 cu. yd. of concrete in the pump pit alone, the other structures totaling 2600 cu. yd. of excavation and 540 cu. yd. of concrete, all classes.

Hoist on Revolving Headframe Operates Dragline

Screening Plant Used as Cableway Tower, Designed to Give Straight Lead from Hoist in Excavating 160-Degree Sector

THE ADVANTAGE of having the hoisting engine operating a dragline cableway always square with the load and track lines is accomplished in a sand and gravel plant at Barton, Wis., by mounting the engine in a rotating headframe on top of the main structure, 61 ft. above ground. The plant has a nominal capacity of 600 cu. yd. per 10-hour day. It has been in satisfactory service since June, 1914, and there is little vibration due to the elevated position of the engine, according to the designer. Aside from the above features the plant does not differ materially from many others recently constructed to operate with drag-line equipment. It is located across the shipping track from the working face of a glacial deposit about 40 ft. high. Property ownership practically decided this location of the plant, from which the deposit can be worked to the extent of 160 deg. with the receiving hopper as a center.



REVOLVING HEADFRAME SUPPORTS HOISTING ENGINE 61 FEET ABOVE GROUND

On top of the structure carrying the washing and sorting screens is a platform 19½ x 28 ft. in plan, on which the rotating headframe rests. The hole for the receiving hopper, which is placed 3 ft. off the center-line of the tower, is made the center of rotation of the headframe. Two circular steel tracks of flat plates for the headframe are laid concentrically around the hopper. The outer track is not a complete circle, as the frame will never need to be swung all the way around. Details of the headframe are shown in an accompanying drawing. A roof over the hoisting engine protects the operator from flying stones, and the small window through which the operator watches the bucket is covered by a stout screen.

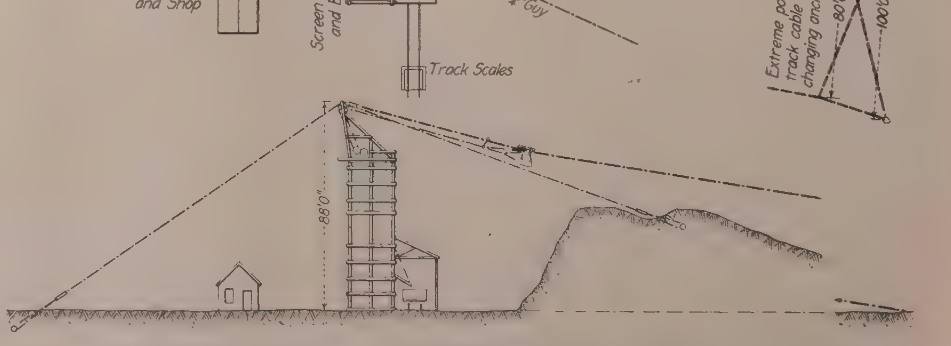
SLIDING OF TURNTABLE PROVIDED AGAINST

As the headframe rotates it is maintained in place by a heavy angle-iron ring securely bolted to the upper platform of the screen tower. The angle-iron ring fits inside an octagon of 4 x 8-in. timbers bolted to the under side of the headframe. The octagon has an inside diameter of 6 ft. and the ring, a diameter ½ in. less. To the bottom of the headframe base are fastened twelve steel rollers arranged radially. They support the headframe only while it is being rotated, when all strain is off the 500-ft. track cable and guys. While the rig is at work excavating, it is supported by wooden shims driven under the base timbers, and is securely anchored to the screen tower by 1¼-in. bolts arranged in pairs along the sills of the headframe.

As indicated on the general plan, which shows the first setting of the dragline cables and guys, the two back guys are arranged so that they need not be disturbed nor the headframe rotated until the track cable has been shifted to the full extent of the bridle cable. For this reason the shifting of back guys and anchorages is only necessary at considerable intervals. Runs of more than two months' duration have been made from one setting. The dragline outfit, which is equipped with a 1-yd. bucket, was furnished by Sauerman Brothers, of Chicago.

DROP CHUTE HAS SHELVES TO CHECK VELOCITY OF MATERIAL

From the receiving hopper the material passes through the center ring to a grizzly screen. The oversize goes to a gyratory crusher on the ground by way of a drop chute, and the remainder to a series of six washing and sizing screens arranged in the usual manner. To check the velocity of the material in the drop chute, horizon-



PLAN AND ELEVATION OF PLANT—FIRST SETTING OF CABLES AND GUYS

The two back guys are arranged so that they need not be disturbed, nor the headframe rotated, until the track cable has been shifted to the full extent of the bridle cable.

tal wooden shelves, extending out alternately from each side, are built therein 2 ft. 10 in. apart. These shelves in operation fill with gravel, thus forming a zigzag chute with little surface exposed to wear. This exposed surface is protected with steel, the edges of the shelves being faced with a 2 x 2-in. angle, and that part of the sides of the chute exposed to wear being covered with No. 12 steel plate.

Occasional boulders larger than 10 in. in size are caught on a screen of heavy bars located in the receiving hopper, and are sledged by hand to a size small enough for the crusher. The crushed material is returned to the screening plant by a bucket elevator operated by rope drive through a jackshaft from the double-cylinder steam engine which operates the screens.

THE REVOLVING HOISTING ENGINE AT THE TOP OF THE PLANT IS ALWAYS SQUARE WITH THE LOAD AND TRACK LINES IN OPERATION

Wash-water is obtained from a near-by stream through a ditch and tile conduit. The centrifugal pump which handles this water is belt-driven from the jackshaft in the power house. The crusher is belt-driven from the same shaft, but the screens and elevator are operated with rope drive. Steam to run the plant is furnished at 110 lb. per square inch in a 72-in. x 16-ft. horizontal return-flue boiler.

The plant was built by the Barton Sand & Gravel Company, under the general supervision of E. J. Haddock, consulting engineer, of Milwaukee, who designed the plant. C. L. Horner was in direct charge of the construction.

A NEW WALL MAP OF ALASKA has just been issued by the U. S. Geological Survey; it is 82 x 55 in. in size and is drawn on a scale of 23.7 miles to 1 in. The map comprises all the information collected in the course of the eighteen years of systematic surveys which this department has conducted in Alaska. During this time about 150,000 sq. mi., or more than 25 per cent of the total area of Alaska, has been mapped. Detailed attention has been given to the coal fields of the Matanuska and Bering River districts, as well as the region traversed by the proposed Government railroad. The largest unsurveyed areas lie in the northern part and in certain portions of the Kuskokwim River basin.

Registration Law Aims Solely at Raising Professional Standards

So Explains Chairman of Committee Which Promoted the Statute Affecting Architects in New York State

ON PAGE 706 of the Engineering Record of June 5 there appeared a synopsis of the law, recently effective, covering the registration of architects in New York State. As there noted the statute contains nothing discriminatory to the engineer. It merely specifies who shall be entitled to be designated as a "registered architect." It does not, like the Illinois law, require that building plans must bear the stamp of a registered architect before they can be approved.

This point of the possible restrictive effect of the law came up during its discussion. The resulting situation is described in the report of D. Everett Waid, chairman of the joint committee of architects promoting the bill, to the president of the New York Chapter of the American Institute of Architects. It indicates that the New York architects gladly disclaimed any desire to use the measure to force business their way.

The following quotation is taken from Mr. Waid's report:

OPPOSITION ENCOUNTERED

"The joint committee in its efforts to secure the passage of this bill encountered a strong sentiment of opposition on the part of the Legislators, not to anything specific in this bill, but on account of their prejudice against license bills in general; and it was somewhat difficult to convince them that this is an educational measure and not a license bill to be likened to such bills as have been introduced in behalf of the plumbing and heating trades.

"Unexpected opposition also appeared when the attorney representing the Building Trades Employers' Association made active efforts to secure the defeat of the measure. . . . We found that an amendment to the bill, which would be in effect a declaration of purpose and which would in no sense change its meaning or effect, would secure the withdrawal of their opposition. This amendment reads thus:

" 'Nothing in this article shall be construed as depriving any person of any rights which he now has with respect to the filing of plans for new buildings or for alterations to existing buildings; nor shall any department or bureau, or superintendent of any department or bureau, with which plans are required to be filed according to law, refuse by reason of this article to receive the same from any one on the ground that the plans are not prepared by a person styled or known as architect.'

ASSENT TO AMENDMENT

"Our joint committee, representing all five organizations of architects, joined in requesting the Legislators in charge of the bill in Albany to secure the passage of this amendment. For some reason, those in charge of the bill disregarded our request and the bill was passed without the amendment. This was a very embarrassing outcome, as it placed us seemingly in the position of securing the passage of the bill by a trick. The association was immediately aroused to make the greatest possible effort to secure the veto of the bill by the Governor. Conferences again resulted and opposition to the signing of the bill was withdrawn on our promise to use every sincere effort to secure the passage of this amendment to the bill at the next session.

"In view of the unfortunate experience in Illinois, where, after a law had been in force twenty years, the Board of Examiners has become a football of politics and the laws in existence jeopardized by opposition on the part of the engineers and others, your committee believes that it will be wise to have this amendment passed, as it will make clear beyond a doubt our purpose to raise the standard of qualifications of architects and not to secure business by force of legislation. The penalty to be incurred under this law is for the use of the title architect by any one not duly qualified. We believe that building laws should be made stringent enough to locate responsibility for unsafe design and bad construction. If owners then choose to employ contractors or others to design their buildings, they will do so knowingly and without being deceived by unscrupulous persons, who assume the title 'architect' unworthily and thereby discredit the profession."

GROSS OPERATING REVENUES FOR MARCH on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economies, were $1012 per mile, showing a decrease of $79 or 7.3 per cent as compared with March, 1914. Operating expenses were $720, a decrease of $81 or 10.2 per cent. Net operating revenues, therefore, were $292—an increase of $2 or 0.7 per cent, and operating income was $243—an increase of $3 or 1.2 per cent. The operating ratio was 71.2 per cent, as compared with 73.4 per cent in March, 1914, and 74.5 per cent in March, 1913. Considering the three main districts, the respective ratios for March, 1915, and March, 1914, were as follows: Eastern district, 74.0 and 78.3; Southern, 70.3 and 70.6; Western, 68.3 and 69.2. It will be noted that the operating ratio for the Eastern district in March, 1914, was very high.

Point Defiance Line Eliminates Last Heavy Grade Between Tacoma and Portland

New Tacoma-Tenino Route Along Puget Sound Completes Reconstruction Program for North-and-South Line of Northern Pacific in Washington

By DAVID L. SOLTAN
Tacoma, Washington

LAST DECEMBER the Point Defiance line of the Northern Pacific Railway was turned over for operation, without any formal ceremony other than the customary inspection and approval by the various heads of departments. This marks the close of the reconstruction and double-tracking of the Northern Pacific main line between Tacoma, Wash., and Portland, Ore., and now provides a continuous double-track line from Seattle to Portland.

The original line was built in the early seventies, the first train arriving in Tacoma in 1873 and for many years this line was the sole railroad connection between Puget Sound and the outside world. Leaving Portland, the old line followed the banks of the Columbia and Willamette Rivers to Goble, Ore., where it crossed the Columbia, by ferry, to the Washington side at Kalama. It ran thence along the river bank to Kelso, at which point the Cowlitz River empties into the Columbia, which now turns and flows directly west. Continuing up the Cowlitz valley, the road passed through the towns of Castle Rock, Winlock, Napavine, Chehalis, Centralia and Tenino, thence through Lakeview to Tacoma.

This line is the only direct connecting link between Puget Sound and Portland, and for many years was operated solely by the Northern Pacific. In 1909, however, the Great Northern Railway and the Oregon-Washington Railroad & Navigation Company were admitted to joint use of the line between Tacoma and Vancouver, Wash. Traffic conditions were, of course, materially altered, and together with the rapidly increasing traffic due to the growth and development of the surrounding territory, the existing facilities became insufficient to handle adequately the larger business, and it became imperative that the line be thoroughly revised and rebuilt and additional facilities provided where needed.

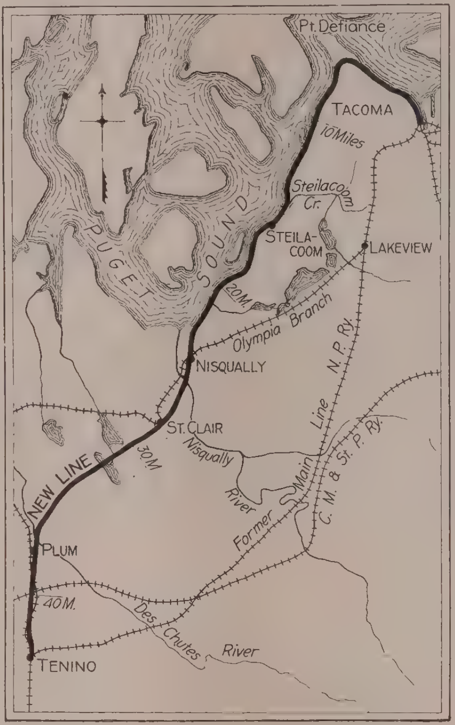
In the meantime the Spokane, Portland & Seattle Railway had constructed a double-track bridge across the Columbia at Vancouver, and the old ferry service was discontinued, all four railroads using the bridge.

Reconstruction Begun in 1907

In 1907 the work of rebuilding the line was begun, the first part to be reconstructed being the 30-mile section lying between Vancouver and Kalama. The alignment was thoroughly revised and a double-track roadbed constructed, upon which, a year later, the second track was laid.

The section lying between Kalama and Tenino was next in order, and here the problem of alignment and grade was different from that in the preceding work. In the former section the line paralleled the river and the revision consisted chiefly in straightening out the old main and securing the roadbed against all danger from high water. In this next section, however, there were adverse grades in both directions, and a high percentage of curvature, necessitating considerable heavy work in order to eliminate the worst features.

As finally built the line follows the old location in the main, but there have been several minor relocations, notably at Kelso, Castle Rock and the crossings of the Toutle and Cowlitz Rivers. At Castle Rock the Cowlitz River makes a sharp bend around the promontory that gives its name to the town, and the old line followed to some extent the windings of the river. This portion was relocated almost entirely on tangent, and although the present town is left at some distance from the new line (the station is outside the corporate limits) many degrees of curvature are eliminated and a much easier track to operate and maintain is provided. At Kelso a somewhat similar situation was encountered, but in this case the line was straightened by tunneling through the bluff and building a double-track, concrete-lined tunnel 1150 ft. long. At the river crossing mentioned above the old bridge sites were abandoned and new double-track structures erected at considerable distances from the former crossings, in this way providing a better line, grade and waterway.



NEW AND OLD TACOMA-TENINO LINES

Although the new line increases the mileage 4.53 miles and the curvature 523 deg., it reduces the maximum grade from 2.2 to 0.3 per cent.

The total effect, of the revisions in this section was to shorten the line by 1 mile, eliminate much adverse gradient and provide a line with a maximum grade northbound of 0.9 per cent and southbound of 1.0 per cent, the total length of these grades being about 4 miles each on either side of the Napavine hill.

Tacoma-Tenino Problem

The remaining forty-odd miles between Tenino and Tacoma presented the hardest problem in the matter of revision and betterment. The grade line was very broken, with frequent 1.0 per cent adverse grades in either direction, the curvature was high, and ascending from Tacoma there was 2¼ miles of 2.2 per cent grade. The location of the Tacoma station was such that a reverse movement was necessary in getting into or out of the station yard, the throat of which was crossed at grade by the freight mains. The situation was further complicated by a highway grade crossing which, owing to local conditions, could not very well be eliminated, and which carried a very heavy travel. This was located less than a quarter of a mile from the station. The improvement of this stretch of line was practically impossible, although the line after leaving Tacoma, was comparatively easy of betterment without undue expense.

The only solution to the difficulty, through the city, then, was to find another outlet that would do away with this mountain grade, and the Point Defiance line was the answer. It provides a practically level line for the first 18 miles, broken only by a slight rise at Point Defiance to secure drainage for the tunnel and obtain better approaches to the portals. This level stretch is followed by 26 miles of 0.3 per cent ascending grade, with level stretches here and there at stations. Reference to the map will indicate the general course of the line.

Old and New Line Compared

The distance between Tacoma and Tenino via the new line is 43.71 miles, as against 39.18 miles on the old line—an increase of 4.53 miles. The total curvature is also increased from 824 to 1347 deg., this marked increase being due to the irregularity of the shore line of Puget Sound. Against these seeming disadvantages must be set the following: The maximum curvature is reduced from 10 to 3 deg., the total rise and fall from 1244 to 428 ft., and the maximum grade from 2.2 to 0.3 per cent. The tonnage rating of the freight engines now in use on these divisions is 2000 on the old line with helper service up the Tacoma hill; yard engines were used for this work and three were needed for tonnage train. On the new line the rating for the same locomotive is increased to 3000 tons, and capacity trains can be hauled from Tacoma to Portland, except up the Napavine hill. This exception will not interfere with operation as far south as Centralia, at which point new yards and engine facilities have been constructed. This point is the distributing center for the Grays Harbor and Willapa Harbor country, in which are located the thriving lumbering towns of Hoquiam, Aberdeen, Cosmopolis, Raymond and South Bend, and which are the sources of a large local business, together with the numerous lumber and shingle mills in the adjacent territory.

In addition to the yards at Centralia, the yards in Tacoma are being thoroughly rearranged and enlarged. The Half-Moon yard, which is cut in two by the new line, has been rearranged, and the Head-of-Bay yard is now being enlarged to twice its former capacity. Inside the switching limits of Tacoma there will be four main tracks, the two passenger mains and an open running track on either side. These will be increased to six when the two freight mains are built.

Two steel and concrete viaducts have been built in Tacoma at each end of the passenger station yard to carry street traffic over the main tracks, and a third viaduct is now in process of erection on River Street, across the Head-of-Bay yard.

CONSTRUCTION FEATURES

The Point Defiance line was located as a four-track line. The two westerly tracks have been built, and provision was made for the two future tracks. On the present construction approximately 7,500,000 cu. yd. of material have been moved and 4500 ft. of double-track bridging constructed. That portion of the new line along Puget Sound presents the most interesting features, viewed from an engineering standpoint. Along this district the heaviest work was encountered, for the reason that very little support could be obtained for the line, and it was located very largely in the sound and is supported only on occasional points of land. Subgrade is about 4 ft. above high tide, and on account of the swift tidal currents along the shore it was necessary to protect the embankment with a rock seawall.

In building this seawall the contractor first drove a temporary trestle parallel with and distant 15 ½ ft. from the nearest main track. There were three piles to the bent and bents were spaced 15 ft. on centers. The inner side of the outer piles was planked with 6-in. planking to a point 2 ft. above high tide. Against this planking riprap rock was placed; the first was handled from scows and the top courses were placed by derricks from the trestle.

As the building of the rock wall progressed on the outside of the trestle the roadbed proper was filled in behind and kept up to the same general level of the rock. Puget Sound waters are infested with the teredo, and the rock filling was placed as soon as possible after the trestle was built and ready for use, but not infrequently piles had to be replaced in less than three months, as they had been eaten clean through. In the construction of the seawall, 12 miles in total length, 250,000 cu. yd. of rock were used, and in the temporary work the contractor used 525,000 lin. ft. of piling, 7,250,000 ft. b.m. of timber and 1,400,000 lb. of iron.

PRINCIPAL BRIDGES

Three steel bridges were built, over the Deschutes and Nisqually Rivers and Steilacoom Creek waterway respectively. The bridge at the latter point is a Strauss patent direct-lift draw span, 95 ft. in length. The Nisqually bridge is composed of three 150-ft. deck spans with a 100-ft. deck plate girder at each end. The Deschutes River bridge consists of one 120-ft. deck span and two 50-ft. plate-girder approaches.

The tracks are laid with 90-lb. open-hearth steel on untreated ties. Automatic block signals are in process of installation, to replace the manual block system.

The contractors for the grading and substructures between Tacoma and Tenino were Porter Brothers. The work in Tacoma was done by the Keasal Construction Company, and the late Nelson Bennett had the contract for the tunnels. The work was done under the direction of W. L. Darling, chief engineer of the Northern Pacific Railway. A. R. Cook, principal assistant engineer, was in charge of the work in Tacoma, and the late J. C. Breedlove, assistant engineer, was in charge of the work from Tacoma to Tenino. The bridges were designed in the office of H. E. Stevens, bridge engineer.

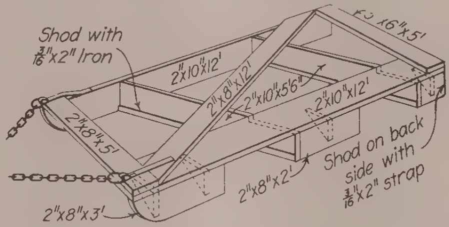
How Minnesota Maintains Her Earth Roads

Highway Officials Design Home-Made Road Planer—Advice Given and Rules Laid Down on Road Dragging

CONSISTENT use of the Minnesota road planer, a non-patented device designed by the Minnesota Highway Commission, will give a smoother roadway than can be obtained by other means, according to its inventors, and is recommended by them. The construction of the planer is simple, as may be seen in the accompanying drawing. The following information on road dragging has been culled from the commission's latest annual report.

WINTER DRAGGING NEGLECTED

When the roads have frozen up very rough in the early winter, the sharp points sometimes become softened and dried out a little by sunshine and wind. At this time the planer or drag may be used to good advantage, making the roads much smoother during the remainder of the winter and helping them immensely during the breaking up in the spring. Most localities neglect winter dragging, and it is only in those places where it has been tried that its value is fully appreciated.



SMOOTH ROADS ARE OBTAINED BY USING MINNESOTA PLANER

Ordinarily the best time to drag the road is soon after a rain as the material will move and compact readily and will not be cut up, nor form mud from traffic following the drag. Do not drag the road when it is dry and hard. If the surface material be moist the smearing section of the planer or drag tends partly to close the pores which occur in earthy material and forms a surface more or less impervious to water. Moist earth is easily cut from the high points and moved to fill the ruts. Dragging the roads once or twice while they are slushy is advisable, when there are deep ruts in the road or just before freezing weather. Particular attention should be paid to keeping the roads well dragged when the frost is coming out of the ground in the spring and during the frequent rains at that time of the year.

EFFECT ON VARIOUS KINDS OF ROAD

Newly constructed gravel roads are especially benefited by the use of the planer. While the gravel is being compacted by traffic the planer should be used constantly to keep the surface smooth instead of allowing ruts and waves to form. Old gravel roads should be dragged very soon after a rain when the surface is soft and will yield to scraping. Macadam roads that are built without rolling can be kept at the proper cross-section and free from ruts by dragging. After the macadam road is compacted the drag is not recommended as it will loosen some of the projecting stones and cause the road to ravel.

The benefits derived from dragging sand roads are not so great as with other classes of soil, but nevertheless the planer or drag has its uses on sand. This is especially true where the road surface is composed of top soil or vegetable matter which has a tendency to wash away or be thrown to the roadside by vehicles. This may be remedied by dragging the material back on the road, but on this class of soil care must be taken not to work up a high crown. A reasonable amount of moisture in sandy roads is advantageous and therefore the crown should be nearly flat.

HOW TO DRAG SUCCESSFULLY

Under ordinary conditions a good two-horse team will pull a drag on earth roads. The drag should not move faster than a team would walk. Usually the hitching link should be in such a position that the runners will make an angle of from 60 to 45 degrees with the center line of the road when the driver stands in the line of draft. By placing the hitching link nearer to the ditch end of the drag the blade can be made to cut as a plow and may be used for cutting weeds or moving a furrow of earth. This hitch is to be used also when the principal purpose of the dragging is to increase the crown of the road. When the sides of the road have been dragged it is usually best to diminish the skew, or run the drag without skew, so that enough material may collect in front of the runner to fill the ruts instead of leaving a ridge of loose earth along the center of the road.

The road surface should be kept as hard as possible and only enough loose earth should be moved into the center to fill the ruts and depressions. An excess of loose earth in the center causes dust in dry weather and mud in rainy weather and will also cause traffic to move to the side of the road. The length of the draw chain must be varied to suit the height of the horses, the arrangement of the harness, and to regulate the depth of cutting.

The driver should not be seated but should shift his weight on the drag to suit the conditions that are met. By shifting his weight forward and backward he can vary the depth of cutting and by stepping toward the discharge end of the runners he can deposit a load of earth in a low place. If he wishes to carry some material with him, to fill a rut or depression, he may do so by stepping to the ditch end of the runners.

ORGANIZATION INTO DISTRICTS

The work of dragging should be organized and systematized if good results are to be obtained. It is best to lay out the dragging district and organize the forces during the winter. If the services of capable and interested men living along the road can be secured, the roads to be dragged should be laid off in about three-mile sections, with a district overseer in charge of the sections, having authority to order out the resident draggers, as mail cannot be timed properly to reach all parts of the district. The importance of having experienced and competent men to do the dragging can hardly be overestimated.

SUMMARY OF RULES

The Commission concludes its advice with the following rules: Get a system; drag after every rain; use a light drag; drag when the road is wet, not sticky; ride the drag and shift weight as needed; don't delay; don't use incompetent men; don't try too much in one trip, and, lastly, don't neglect winter dragging.

Portable Mixer Uses Old Asphalt for Pavement Patches

Fifteen Men Take Up and Relay 180 Square Yards of Paving in One Day at Operating Cost of 42 Cents per Square Yard

IN RELAYING asphalt pavements adjacent to street-car tracks the traction company in Milwaukee is using a ¾-yd. hot mixer, fed with the material cut out in making patches and repairs. The company has a large stationary plant but has found greater economy in utilizing the portable outfit on three jobs aggregating 3 miles recently completed. The mixer used, which is a Koehring, is run, including the charging, hot blast and propelling apparatus, by a 15-hp motor run at 550 r.p.m., fed from the trolley. For long moves from one part of town to another the outfit is drawn by a utility car or horses.

Fifteen men in a working day have taken up and relaid 180 sq. yd. of asphalt pavement from 2 to 3 in. thick located between the rails. The entire operating cost on the plant, including team charges, but not depreciation or interest on the special investment, has been about 42 cents per square yard for patch work. This includes tearing out and repaving with old material and such small amount of new material as is required.

Repair Procedure

The procedure is to repair one track at a time and maintain uninterrupted car operation over both tracks without blocking vehicular traffic except on one side of the street.

The gang consists of the following men: One foreman, one man breaking up asphalt, one man feeding the mixer, five men preparing concrete and sub-base and wheeling remixed asphalt, one man painting paving stones with hot asphalt and applying the cement to the surface of the finished pavement, one man running the mixer, one man wheeling hot asphalt, three men raking, smoothing and tamping, one night watchman and one teamster. In addition to ripping up the old asphalt and relaying the pavement, this gang also keeps the street in safe operating condition. A two-horse team also is a part of this outfit.

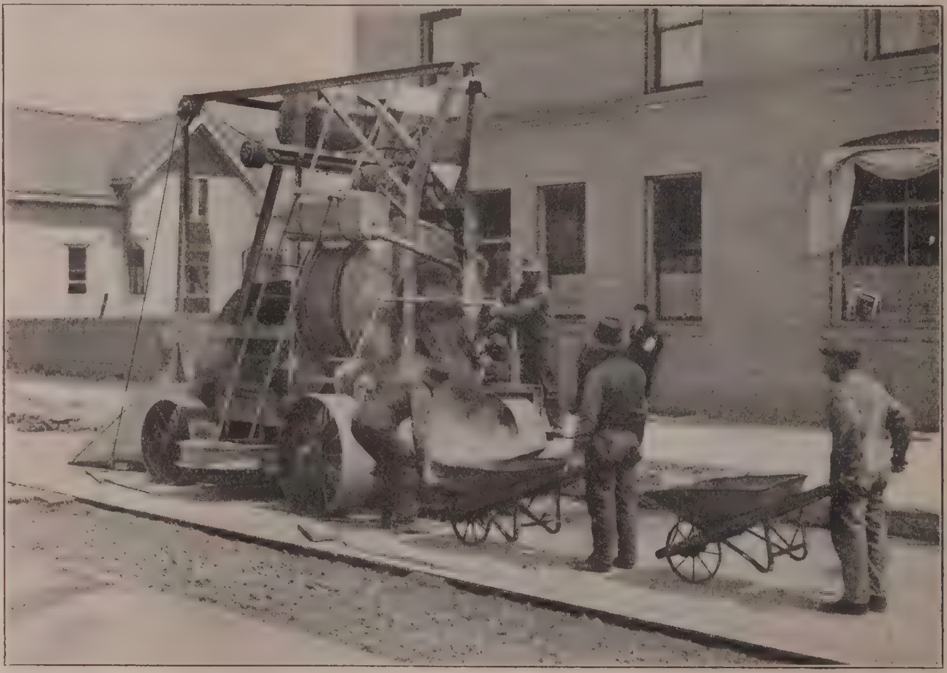
The procedure of the work from front to rear is as follows: On the jobs recently completed a part of the work consisted in relaying the asphalt between the granite gage blocks on a busy double-track line. The old asphalt surface is first picked up and thrown over to the side of the street. Then the larger pieces are broken into pieces about 6 in. square, the smaller sizes being more readily melted. The mixer is charged with approximately 8 cu. ft. of this old material, and new asphalt in varying amounts, usually about 10 lb. per charge, is added in accordance with the character of the old mix.

Time Consumed

About 9 min. are required for melting and mixing a charge. During the first 6 min. the maximum hot blast is applied, and the temperature is then reduced for the last 3 min. The blast is furnished by a blower driven by the main motor. This blower operates in connection with two crude-oil burners, the flame from which is distributed in such a way that only the hot-air blast, and no flame, strikes the mix. This prevents burning. The oil consumption is about 50 gal. per day. Crude oil is purchased in tank cars and delivered to the job in a steel tank which holds 310 gal.

After a mix has been heated it is discharged into two-wheel concrete cars and immediately dumped in the track. Then it is raked, tamped and smoothed in the usual manner. Afterward a surface is given it by rolling with a hand roller loaded with water.

Representatives of the Milwaukee Electric Railway & Light Company, who are handling the work with day labor, state that the quality and speed of work performed with this hot-mixing outfit will improve with experience in its operation, but they are now satisfied that the unit costs, particularly for pick-up and patch work, are considerably lower than those which usually obtain for similar work executed under the old methods or under contract.



PORTABLE PLANT WHICH RENDERS OLD ASPHALT SUITABLE FOR PATCHING PAVEMENT BETWEEN CAR TRACKS IN MILWAUKEE

Cases of Excessive Corrosion of iron and steel bridges are detailed and illustrated in a paper by Frederic H. Fay presented recently before the Engineers Society of Western Pennsylvania. Badly corroded truss eyebars of steel are pictured, in which a loss of nearly 70 per cent of the section occurred in the worst case. Casual examination of such structures fails to give a true idea of their condition, as the rust scales were so thick that loss of section could not be detected. Protection by the use of reinforced concrete securely attached to the steel is recommended, also the use of excessive metal section or even extra cover plates in locations particularly exposed to corrosion. The bottom flanges of overhead beams should be treated by the latter method, in the opinion of Mr. Fay. The most noticeable causes of corrosion are given as exposure to locomotive gases, exposure to sea water or surface water leaking through the bridge floor, and over-stress of metal which hastens corrosive action. Brine drippings from refrigeration cars on railroad bridges and coal-tar mixture dropped from wood-block pavement which removes paint were also mentioned as agents of corrosion.

Tests of I-Beam Connections Made at Cornell

American Bridge Company Revises Its Standards as a Result of a Laboratory Investigation of Riveted Joints

TESTS of beam connections have recently been made in the Cornell University Laboratory at the instigation of James H. Edwards, assistant chief engineer of the American Bridge Company. Eighteen tests were made on 15, 12, 10, 8 and 6-in. I-beams 4 ft. long, with clip angles shop riveted through their webs. Two tests for each size were made with the old standard clip angles of the American Bridge Company, and (for all except the 6-in. beams) two tests for each size using special connection angles with simpler web connections and fewer web rivets.

New Standards Adopted

As a result of these tests the special connections for the 15, 12 and 10-in. beams have been adopted as standards by the American Bridge Company. These special connections were made with equal-legged angles and one row of rivets through the web instead of the 6 x 4-in. angles with two rows used in the previous standards. It was found that the decrease in the eccentricity of the connections offset the loss due to fewer rivets, and the special connections showed nearly as great strength as the old standards, except for the 8-in. beams. The weakness of the latter was due to their relatively thin webs.

The loads were applied symmetrically through 1½-in. steel rollers on bearing plates 6 in. wide in the majority of cases, and at about 6 in. from the ends to provide failure at the connections. One beam, on which the loads were applied at the quarter points, buckled under the load points without producing failure at the ends. Where the bearing plates were not used the beams were badly buckled between top flange and web. Details of the results of these tests are given in an article by C. S. Whitney in the "Cornell Civil Engineer."

HOLES CUT IN ARCH OF TANKS FOR CONSTRUCTION AND OPERATION

Remodeling of Septic Tanks Into Imhoff Tanks Eliminates Odors from Land Irrigation

Nuisance from Septicized Sewage in California Fields Abated at Small Expense by Introducing Two-Story Feature in the Existing Type of Tank

PERSISTENT complaints of odors caused by the irrigation of lands with the septic sewage from the disposal plant of Orange, Cal., led to the successful conversion of the existing septic tanks into Imhoff tanks. An extensive study of the situation was carried out, which indicated that odors were frequently observable under favorable wind and moisture conditions at air-line distances of 2000 to 2500 ft. from the tanks and on rare occasions 4000 ft. The difficulty seems to have been produced not so much from the odors arising directly from the tanks, but from the liberated sulphuretted hydrogen gases released from the septicized sewage after the latter had been spread out over the adjoining farms and particularly when allowed to pool. High sulphate content in the well water furnished an abundant source for the noisome gas.

Orange is a city of 4000 inhabitants engaged principally in citrus fruit growing so that the sewage is practically all domestic in character, about 100 gal. of water per capita being used. About 1900 persons are served by the sewerage system.

EXISTING TANKS AND DISPOSAL CONDITIONS

In 1912 two adjoining concrete septic tanks, rectangular in the lower portion and semi-circular in the upper portion, were constructed. They are 70 ft. long, 10 ft. wide and have a total depth varying from 10.9 ft. at the inlet to 10 ft. at the outlet; the sewage depth is 3 ft. less. The gross capacity is 39,000 gal., equivalent to 6¼ hours' flow of the average daily volume and 4½ hours' flow of the maximum. It is said that the tanks were well designed, but that the type is faulty under the Orange conditions, because it necessarily causes a gas-laden septic effluent to pass from the tanks. Disposal of the effluent as irrigation water was stipulated in the contract by which the city acquired the disposal site, and from soil analyses the lands were reported by the investigating engineer to be excellently adapted to sewage irrigation if dosed with from 4000 to 5000 gal. per acre daily, but nevertheless vigorous complaints arose from its use. Most of the sewage was disposed of over an 18-acre tract, but occasionally a 34-acre tract received some of the effluent. One site near the Santa Ana River is covered with a fine sand on which 10,000 to 20,000 gal. could be disposed of, while a removal of the upper 12 in. would fit it to receive 50,000 to 75,000 gal. per day of settled sewage. Examination of the dry river bed indicated that by underdrains the volume per acre could be increased to 100,000 or 150,000 gal. per day.

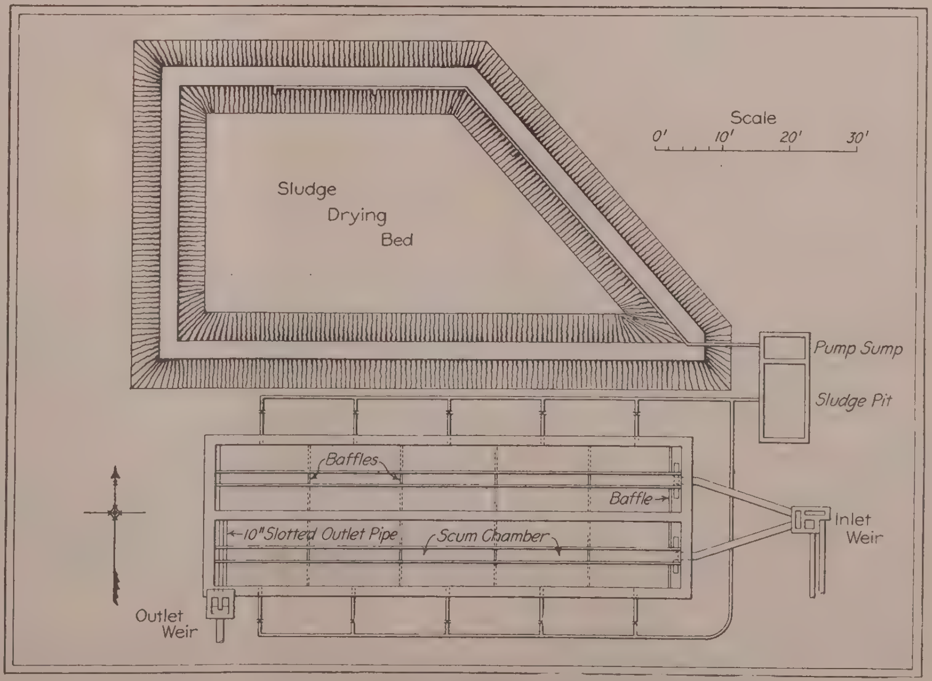
THREE METHODS AVAILABLE

Three available methods of disposal open to the city were: First, construction of 3.7 miles of 15-in. sewer to deliver into a line carrying the sewage of the Southern California Sugar Company's plant (see Engineering Record, Nov. 9, 1912, page 513) and that of Santa Ana to the Pacific Ocean; second, by irrigation of lands west and south of the present septic tanks with settled fresh sewage; third, by intermittent sand filtration of settled fresh sewage in levee-protected beds constructed in the bed of the Santa Ana River. The first scheme would cost $20,000 for the sewer, plus the rental privilege to be exacted by the sugar company. Santa Ana pays $2400 per year rather than use its 115-acre sewage farm. An independent line to the ocean would be 14 miles long and if 18 in. in diameter would cost the prohibitive sum of $90,000. Los Angeles' experience indicated to the engineer that similar future difficulties may arise and compel some treatment previous to discharge even into the ocean.

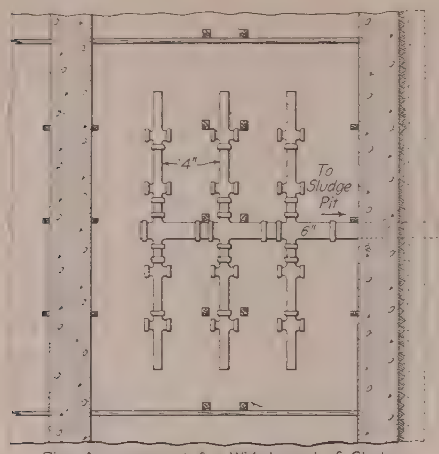
Serious objections to project 3 were probable excessive height of ground water during floods and the inability of any underdrainage system to lower it sufficiently. This would then require occasional use of the effluent as irrigation water. For project 2 the value of city sewage depends on the absolute dependence on the volume in addition to its fertilizer value. The last named method was decided upon, and obtaining fresh sewage was carried out by reconstructing the tanks with wooden flowing-through chambers, converting them into Imhoff tanks so as to obtain some betterment of conditions, as demanded at once by complaining residents. Further, as is usually the case, money was not available for a large outlay and the reconstruction recommended was comparatively cheap and quick of attainment. It was distinctly understood that the revision was proposed as a temporary expedient and one to demonstrate the general applicability and satisfaction of the double-deck tank as respects production of odors.

RECONSTRUCTION

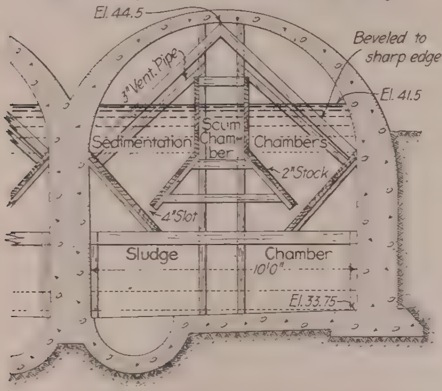
As carried out two sedimentation channels, 4 ft. wide, with sloping bottoms and continuous slots, 3 in. wide, were constructed the entire length of each tank, thus utilizing the lower portion of the tanks for



PLAN OF ORANGE TANKS CONVERTED INTO TWO-STORY UNITS



Pipe Arrangement for Withdrawal of Sludge



Section through One Tank

REBUILT TANK WITH IMHOFF BAFFLES

sludge storage and digestion. Three-inch vent pipes lead from the high portions of the sludge chambers against the walls of the tanks upward through the sedimentation channels to the space above.

To make possible the removal of sludge, tight partitions were built across the sludge chambers every 14 ft. A 4-in. and 6-in. vitrified pipe sludge removal system having thirty openings was installed on the floor of each of the compartments and connected with a sludge pit from which a 2½-in. centrifugal pump driven by a gasoline engine discharges the sludge on to a drying bed.

The engineer considered the scheme employed for sludge removal the most important phase of the entire plan of reconstruction. If it were attempted to remove the necessarily thin layer of sludge from one point only, an inverted cone of least resistance would surely be formed in the sludge, the liquid would be "short-circuited" and would be discharged instead of solids. In this case not only were thirty sludge entrances provided in the sludge removal system for each 140 sq. ft. of floor area, but the outlet pipe of each of the ten sludge removal units of the two tanks was reduced in size from 6 to 4 in. and provided with a 4-in. valve. Thus it was made possible both to control the rate of sludge discharge within narrow limits and to prevent the removal of liquids rather than sludge if the valve were opened wide.

Five 3 x 5-ft. openings were cut in the roof of each tank, for purposes of construction, inspection and the cleaning of the sides and slots.

OPERATING EXPERIENCE

As to operation, George W. Buchanan, superintendent of sewers, states that since placing the second tank in operation in December there is little odor at the plant. What is noticeable is marshy in character, and the people in the neighborhood seem satisfied. The first sludge, removed on Feb. 9, 1914, from the north tank (placed in service on Sept. 16, 1913,) had little odor. An inspection in August, 1914, indicated that the plant was working well, although there was some odor of hydrogen sulphide at the effluent weirs attributed to the fact that the sedimentation chambers have not been kept free from scum, which had attained a thickness of 2 to 3 in. on account of septic action.

It has been found difficult to get at the portions of the chambers which are under the solidly roofed sections of the tanks. Were a 3-ft. slot cut the entire length of the roof the engineer considers it would have been an improvement. Prevention of mosquito breeding has been effected by screening the openings.

Prof. Charles Gilman Hyde, as consulting engineer for the California State Board of Health, made the original investigations and suggestions as to the conversion of the tanks. The reconstruction was carried out under the immediate direction of Mr. Buchanan.

Floor Design of the New Massachusetts Technology Buildings Based Upon Beam Tests

Paper Before American Concrete Institute by Sanford E. Thompson Reports Investigations of Beam Reinforcement and Studies for Economical Floor Panels

SUPPLEMENTING the two articles in this journal last year (see Engineering Record, April 4, page 393, and Nov. 28, page 578) giving a general description and detailing the methods of construction of the new buildings of the Massachusetts Institute of Technology, at Boston, an abstract from the paper presented by Sanford E. Thompson before the American Concrete Institute is here given. The design features include the method used in deciding to adopt twisted steel bars for reinforcing the beams, because of the results of tests showing smaller cracks in beams under load for twisted as compared to plain round reinforcement; the comparative estimates for cost of floor panels with intermediate beams and without, and for hollow tile as well as reinforced concrete, the bending moment coefficients used for continuous beam design, and the investigation to obtain material to give dustless floor surfaces.

FIELD-TEST RESULTS AND THEIR VALUE

A description of the method of taking field specimens was given in the second article above referred to. The average results of these compression tests are given in Table 1.

TABLE 1—RESULTS OF COMPRESSION TESTS OF FIELD CONCRETE

Proportions used	Average strength—lb. per square inch	
	Age 14 days	Age 28 days
1:2:4	1640	2110
1:1½:3	2008	2520

Each value is the average of about 90 specimens, and the per cent of variation from the mean runs much lower than is usual in construction work because of the care with which the samples were taken and molded. The increase in strength from 14 to 28 days for the 1:2:4 concrete averaged 23 per cent and for the 1:1½:3 concrete 25 per cent. The series of laboratory tests conducted last year by the committee on aggregates of the American Concrete Institute showed an increase of 19 per cent in this period.

The practical value of this system of sampling and testing was shown at the beginning of the job. Some of the specimens of 1:2:4 concrete gave low test results. The methods of handling the concrete on the jobs was changed at once and subsequent specimens gave proper strength. To be sure that the concrete which had been previously placed was satisfactory, three or four samples were cut out of the solid footings three or four weeks old. After being sawed to a standard 8 x 8 x 16 in. size, they were crushed and the strengths averaged 2200 lb., a satisfactory figure for this portion of the structure.

The cold twisted steel used for reinforcement was tested at the mill with the following results: Yield points varied from 57,000 to 64,000 lb., and the tensile strength from 70,000 to 81,000 lb. The elongation in 8 in. was 7½ to 10 per cent, and reduction in area was 33 per cent for the larger sizes of bars, and 15 per cent elongation with 50 per cent reduction in area for sizes below ½ in. Bending tests for bars ½ in. and larger were 180 deg. around their own diameters, and for bars below ½ in. 180 deg. flat. Phosphorus ranged

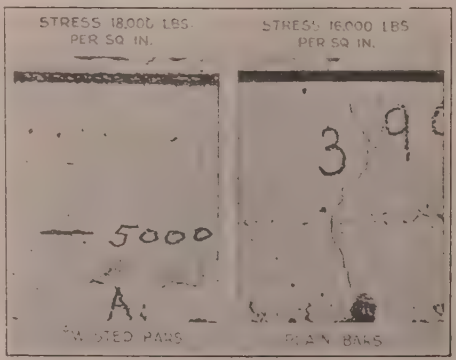


FIG. 1

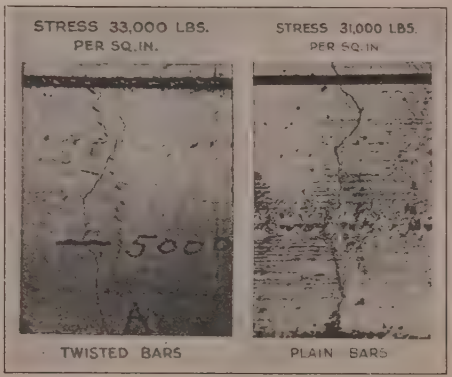

STRESS 33,000 LBS. PER SQ. IN.
STRESS 31,000 LBS. PER SQ. IN.
5000
A
TWISTED BARS
PLAIN BARS

FIG. 2

TWISTED REINFORCEMENT REDUCES SIZE OF CRACKS IN BEAMS

Stresses given are actual, not theoretical, therefore stresses in Fig. 1 are higher than at working loads.

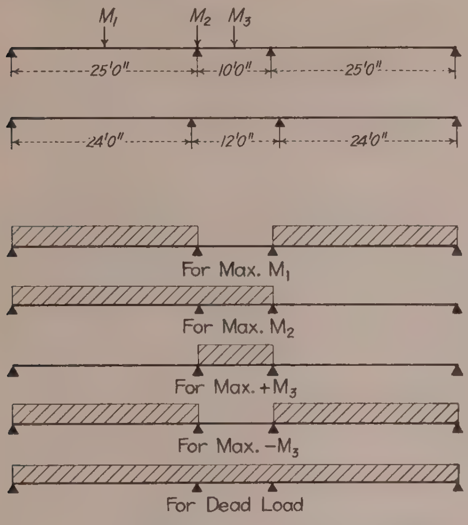


FIG. 3—POSITIONS OF LOADING USED FOR MAXIMUM MOMENTS

from 0.01 to 0.02 per cent and sulphur from 0.03 to 0.04 per cent.

TEST BEAMS FOR CRACKS

The stresses were so chosen that no cracks would be visible under ordinary working load and before reaching a decision on these stresses full sized T-beams were made and tested. As a result of the test it was evident that the cracks in beams reinforced with twisted steel are less objectionable under a steel stress of 18,000 lb. per square inch than cracks in beams reinforced with plain round bars under a stress of only 16,000 lb. per square inch. Moreover, so much of the tension was carried by the concrete that with a theoretical stress of 18,000 lb. the actual measured stress is only 8000 lb. In beams reinforced with twisted steel there were many more cracks than in beams reinforced with plain round bars, but these cracks were all small and were distributed, and therefore unobjectionable, whereas in the beams with plain round bars the cracks were larger and more noticeable.

Figs. 1 and 2 show portions of cracks in two beams reinforced with plain round and with twisted bars, respectively. The crack on the right, Fig. 1, was produced by a 16,000-lb. unit stress in the round steel and that on the left an 18,000-lb. unit stress in the twisted steel. Fig. 2 shows full size portions of cracks in two beams reinforced with plain round and with twisted bars, but carrying about double these stresses. The stress in the steel at failure for beams with twisted steel averaged 93,000 lb. per square inch, and for beams with plain round bars 60,000 lb.

Complete specifications, following substantially the recommendations of the joint committee on concrete and reinforced concrete, were drawn up by Mr. Thompson. The allowable unit stress in the steel was placed at 18,000 lb. In the layout of beams, Fig. 4, there is usually one short span between two long spans. This arrangement gives a series of class rooms on each side of a long corridor with most of the beams in the partitions. Fig. 3 shows the positions of live and dead loads for maximum bending moments for this type of beam. The formulas for the bending moments were derived from the theorem of three moments, and solutions were worked out for the different conditions and the required constants obtained. As a result of these studies, the following simple formulas were used for the three-span continuous beams having the relative lengths shown:

End spans—

$$M_1 = -M_2 = w\,l^2/11$$

Center spans—

$$+M_3 = w\,l^2/60 \qquad -M_3 = w\,l^2/18$$

in which w is uniform load per foot and l is the length of the equal end spans.

COMPARATIVE ESTIMATES OF FLOOR COST

Before deciding on the flat concrete slab with no intermediate beams, studies were made of the relative cost of this construction compared with two other designs. The long span concrete-slab construction proved most economical when the total cost of concrete, steel, and making of forms was considered. Designs and estimates were made for: (1) Reinforced-concrete panels with no intermediate beams, 15½-ft. slabs; (2) reinforced-concrete panel with one intermediate beam, and two 7¾-ft. slabs; (3) reinforced-concrete and tile panel with no intermediate beam, 15½-ft. slab.

The total costs per panel were found by using unit costs of $5.82 for concrete per cubic yard, 2.7 cents per lb. for reinforcing steel, 20 cents per piece for tile, $30 per 1000 for form lumber, carpenter labor at 50 cents per hour, and ordinary labor 25 cents per hour. Forms were assumed to be used four times and remade once for a change in size of columns. The estimated costs per panel are given in Table 2.

It is seen that the saving in costs of forms made the first design the most economical, although design 2 cost least for materials alone. The tile design (3) was highest both for materials and total cost.

TABLE 2—RELATIVE COSTS OF FLOOR PANELS

	Design 1	Design 2	Design 3
Materials	$134.10	$130.00	$150.30
Forms	36.25	48.27	35.20
Total	$170.35	$178.27	$185.50

GENERAL FEATURES OF DESIGN

The beams are all designed as continuous and negative moments provided for. The location of the bends in the steel was always selected so as to leave as much steel as was required for both tension and compression stresses. As a rule, about three-eighths of the shear was considered to be carried by the bent bars in accordance with recent German tests. A typical reinforced beam and its supporting columns are shown in Fig. 4. All interior columns are square and reinforced with vertical steel only. Bands were placed 12 in. on centers to keep the steel in position during construction. The eccentricity of interior columns was neglected, because the short beams were designed with sufficient steel to prevent bending in the columns.

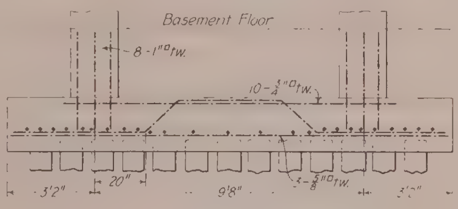


FIG. 5—DETAIL OF TYPICAL FOOTING

In the design of wall columns, account was taken of the bending moment produced by the rigidity of the connection between beam and column. The eccentricity in this case was computed carefully and enough steel provided to take care of it. To provide for the bending moment in the top story, however, it would have been necessary to use larger columns than the architectural treatment would permit. Therefore, to prevent a bending moment in the columns, it was decided to make a joint between the columns and roofbeams and not to carry the outside reinforcement through the beam. Columns were then designed for the superimposed load placed on the column with an eccentricity of 0.4 the width of the column.

The floor slabs, which are continuous, were designed for bending moments $w\,l^2/12$ at the support and at the center of the span. To prevent cracks in the building, as far as possible, short bars were placed on top over each girder, whenever the main slab reinforcement ran parallel to the girder, and, in fact, wherever there was danger of negative stresses. Retaining walls were

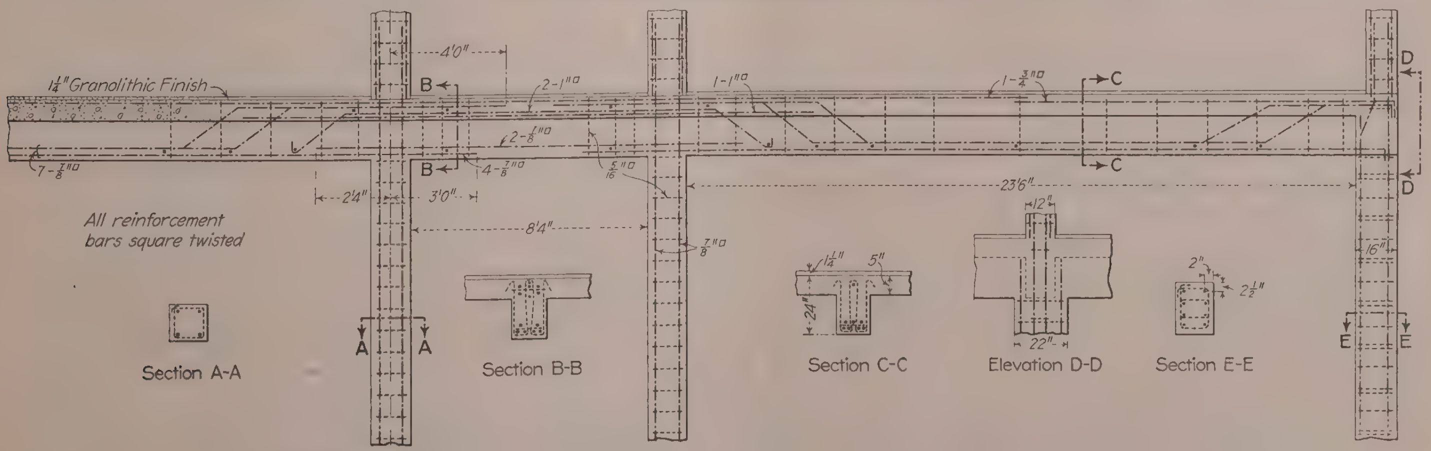


FIG. 4—SPECIAL ARRANGEMENT OF STEEL REINFORCEMENT IN TYPICAL CONTINUOUS BEAM AND COLUMN CONSTRUCTION

cast monolithic with the wall columns except in the outside wall. In the minor and major courts, separate retaining walls were built about 3 ft. 9 in. from the building line.

FOOTINGS AND FLOOR SURFACES

The design of footings varies in different parts of the structure. In certain buildings the interior footings are continuous, in others individual footings are used, and in still others two interior columns are placed on one footing. All outside footings are continuous, and all footings rest on wood piles of spruce or oak, depending upon the character of the ground as determined by thorough tests. Fig. 5 gives a general idea of the design and reinforcement of a continuous footing.

Special studies of floor surfaces were made and several experimental slabs built in order to find the method of placing that would result in minimum dusting and a satisfactory bond with the slab. The scum which always rises on the surface of the base concrete was removed by brushing the slab with a wire brush just as it began to harden. The tests showed that dusting is best prevented by using coarse sand containing scarcely any dust and mixed with broken stone ranging from ¼ to ½ in. in size, using a stiff mortar in the proportions 1:¾:1¼. As a result of laboratory tests, stiff, neat cement brushed into the set concrete was selected as the best bonding material between the base concrete and the granolithic surface coat.

The architect for this work, which is rapidly nearing completion (as illustrated in the Engineering Record, May 15, page 634) is William W. Bosworth, the engineers and builders are the Stone & Webster Engineering Corporation, and the consulting engineers are: Charles P. Main, on footings; J. R. Worcester & Company, on the structural steel; Sanford E. Thompson, on the concrete superstructure, and Hollis French and Allen Hubbard, on the heating and ventilating systems.

TAXES ON SEWAGE WORKS completed last year for the city of Fitchburg, Mass., are a subject of dispute, for the greater part of the new plant is within the limits of the town of Lunenburg. The situation is discussed in the 1914 report of David A. Hartwell, chief engineer, and Harrison P. Eddy, consulting engineer, of the Fitchburg Sewage Disposal Commission. The act authorizing the city to take land in Lunenburg for sewage disposal purposes did not authorize the taxing of either the land or structures. The city solicitor rules, and there are court decisions to that effect, that in the absence of provisions for taxation such property is exempt so long as it is used for municipal purposes and no income is derived therefrom. The Fitchburg commissioners believe that justice to Lunenburg requires the payment of taxes on the land in accordance with the valuation as fixed before the taking, but any such permissive legislation has met with such opposition at the State house as to prevent enactment. The assessors of Lunenburg have placed a valuation for 1914, of $50,000 for land and buildings and a bill for taxes amounting to $810 has been received, but as the city solicitor of Fitchburg has decided that this property is exempt from taxation the commissioners have declined to approve the bill.

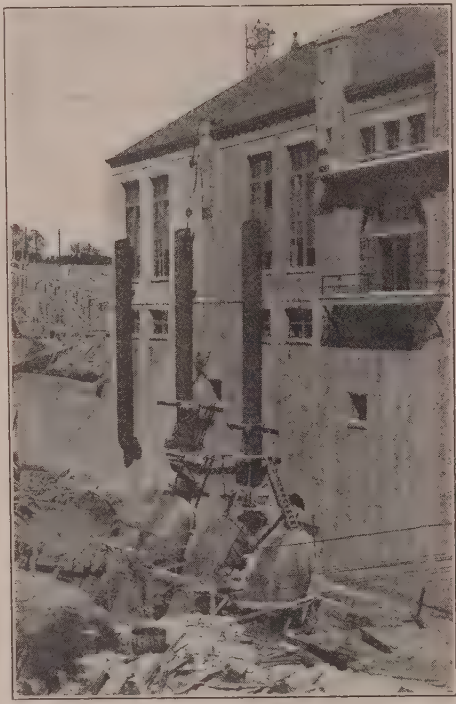
Austin's Hydroelectric Plant Has Unusual Reinforced-Concrete Wheel Casings

Part III of Article on Reinforced-Concrete Structure Replacing Noted Texas Dam Which Failed Fifteen Years Ago

IN Parts I and II of this article the method of stopping percolation through the seamy rock at the site of the Austin, Texas, dam, and the unusual features of the dam itself, its crest and sluice gates were discussed. This, the third and last part of the article, will describe briefly the unusual wheel casings, independent reinforced-concrete boxes, and a number of other details of more than passing interest. Details presenting no unusual features are briefly presented in Table 1.

SURGE PIPES AND VENTS

The power plant is situated at the east end of the dam, its length paralleling the river. As a precaution against water hammer, surge pipes are connected to each penstock at a point near the turbine casing. These surge pipes leave the penstocks horizontally, pass through the wall of the power house on the stream side and then turn vertically upward, being anchored to the wall of the building.



EACH PENSTOCK HAS A SURGE PIPE

Just after passing through the power house wall, each penstock is turned downward to the opening in the turbine casing. This condition is liable to produce collapse of a penstock, if the waterwheel gates be rapidly opened. To prevent this, a vertical, vent pipe is placed on each penstock, just outside the power house wall. Two of these are 66 in. in diameter and one 48 in. The height is such that the water normally stands in them about 4 ft. from the top. It has been found, in practice, that these vent pipes not only prevent collapse of the penstocks, but also act as surge pipes. When the waterwheel gates are rapidly closed, water is ejected from the surge pipes before described, and also from the vent pipes.

MAIN UNITS

General data on the units will be found in Table 1. Each pair of turbine wheels is set in a cylindrical chamber of reinforced concrete.

The generator rotor, the shaft and the waterwheels attached thereto are all suspended from a ball thrust bearing placed on top of the generator frame. The weight of the rotating parts, supported by the top thrust bearing, is 44,000 lb. The waterwheels are, however, designed to produce an upward thrust, when in operation, using the pressure of the water in the turbine cases to produce this upward pressure, which amounts to about 24,000 lb., leaving only 20,000 lb. as the net weight to be carried by the thrust bearings. The bearings are, however, designed to carry 44,000 lb. at 300 r.p.m.

REINFORCED-CONCRETE CASINGS

The reinforced-concrete casings for the turbines, their dimensions, form and method of reinforcement are all shown in the drawings. It is believed that this is the first time that turbines of comparatively small size, and adapted for setting in cylindrical steel casings, have been placed in a cylindrical casing of reinforced concrete. The question of a cylindrical chamber as compared with the usual spiral form resolved itself in favor of the cylindrical casing, because it was believed that if the latter were made of sufficiently great diameter, the efficiency obtained would be nearly equal to that which could be obtained from the spiral form of casing. Moreover, owing to the labor conditions, it cost considerably less to make a large cylindrical casing than a smaller spiral one. The tests of the completed plant have demonstrated that this view was correct, an efficiency of 87 per cent for the turbines having been reached under operating conditions.

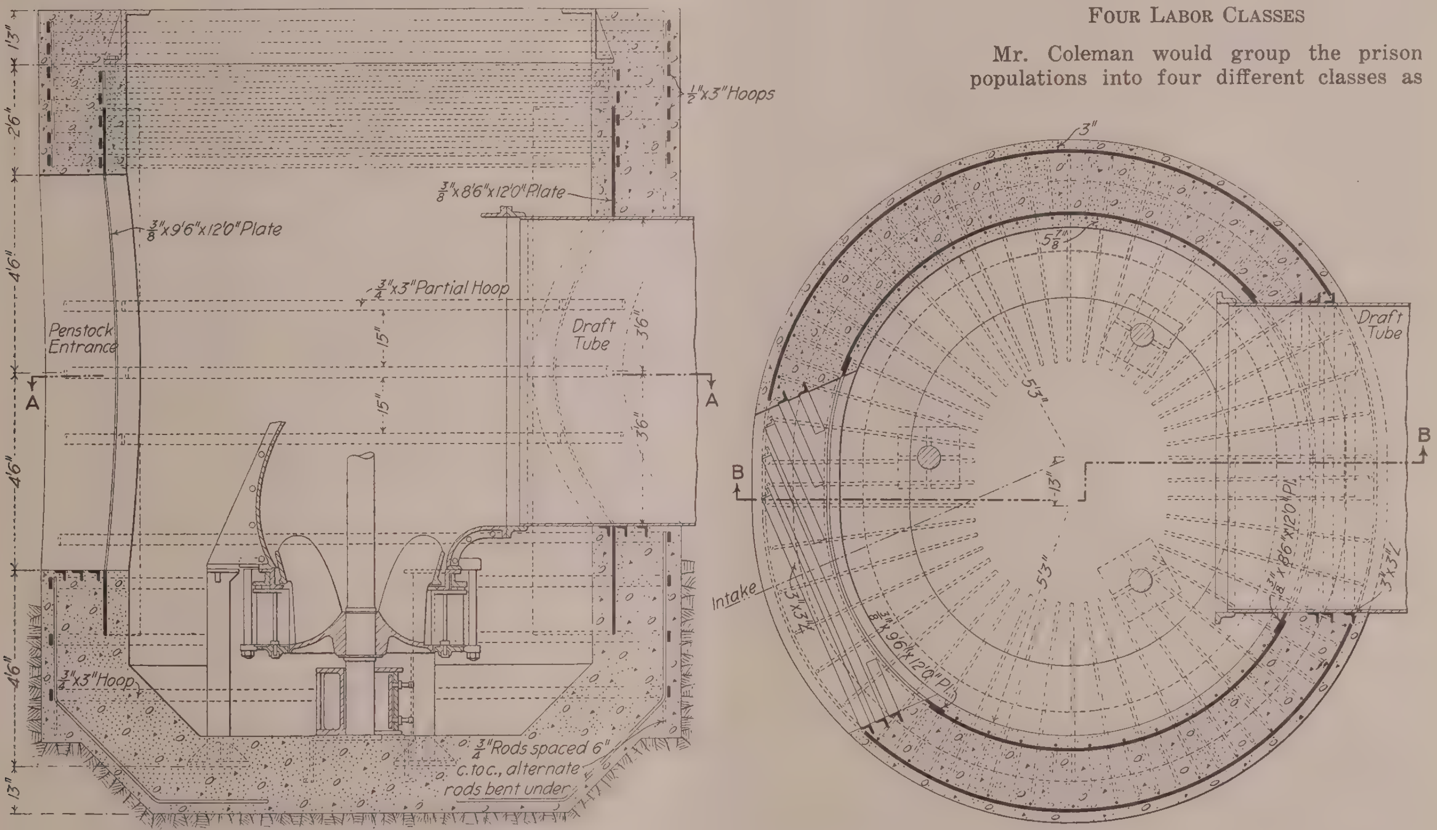
It will be observed that the reinforcement of the casings comprises both cantilever and hoop tension reinforcement. In view of the possibility of cracking the amount of steel used was considerably greater than that customarily employed for ordinary reinforced-concrete work, the stresses being limited to 10,000 lb. per square inch in the steel. Where the penstocks enter the turbine cases, and where the draft-tubes pass through them, angles

TABLE 1—GENERAL DATA ON PRINCIPAL FEATURES OF POWER PLANT

Feature	No.	Material or maker	Size	Remarks
Penstocks	3	Riveted steel incased in concrete	9 ft. diameter	Each penstock fitted with surge pipe.
Headgates	6	4-in. creosoted yellow pine	5 x 10 ft.	Two to each penstock.
Turbines	3	Platt Iron Works Company	36 in. head, 65 ft.	Vertical shaft, two runners on each shaft.
Generators	3	Crocker-Wheeler Company		1800 kw. 6600 v. 300 r.p.m.
Exciters	3	Crocker-Wheeler Company	Two 75 kw., one 15 kw.	Motor driven.
Governors	3	Lombard		17,500 ft lb. capacity.

are riveted around the outer surface of the pipes, so that ample contact with the surrounding concrete is provided. These cases have now been in service nearly four months, and have not shown any cracks or defects. These cases were made of concrete instead of steel, principally because of the height of the vertical turbines and the possibility of vibration unless surrounded with heavy masses.

The top of each turbine chamber is closed by a heavy cast-iron cover, which is ribbed to give sufficient strength to resist the upward thrust of the water. It is split to facilitate erection and dismantling. A cast-iron ring of approximately Z-section is built into the concrete and anchored to it by means of heavy bolts. One flange of this ring projects slightly above the upper surface of the concrete and to it is bolted the cast-iron cover.



Section B-B

Section A-A

CYLINDRICAL REINFORCED-CONCRETE CASINGS WERE SELECTED IN PREFERENCE TO SMALLER SPIRAL CHAMBERS

TESTS

Complete efficiency and heat tests were made on the electrical apparatus before shipment from the factory. The generators, however, being vertical machines, the shop tests could not be made under the same conditions as those which existed after they were placed in the power house. In the shop the generators were tested as horizontal machines, the shaft rotating in horizontal bearings. The friction loss, therefore, was considerably greater than that of the same machines set vertically with the weight of the rotor carried on ball thrust bearings. The results of the shop tests were, however, used to determine the efficiency of the rest of the equipment. The three generators showed practically identical efficiencies, as indicated in Table 2, at the top of the next column.

TABLE 2—SHOP-TEST EFFICIENCIES OF GENERATORS

Load	Efficiencies at power factors of	
	100 per cent	80 per cent
½	93.6	91.9
¾	95.4	94.0
1	96.2	94.8
1¼	96.6	95.3

In order to make an efficiency test of the complete equipment, a weir was built in the tailrace, which was provided with a notch 3 ft. in depth and 29 ft. in length, so that with the full load of 1800 kw on one machine and full head of 65 ft. the quantity of water required gave a height of about 33 in. over the crest of the weir. A 6-hour test was conducted on each of the units.

The total efficiencies, from the gross energy in the water to the electrical energy delivered at the switchboard varied but little between the three units, the maximum difference being not over 1¼ per cent. The average, over-all efficiency at full load was 83½ per cent, which showed the average efficiency of the waterwheels to be 87 per cent.

The load was practically non-inductive, as it was made up of iron-wire resistance coils submerged in shallow tanks, a continuous supply of water being delivered to the tanks to keep down the temperature. The actual resistance of these submerged wire coils was considerably less than the computed resistance, and, on investigation, it was found that the cooling water was sufficiently impregnated with alkali and salts of various kinds to reduce its normal resistance considerably and act, in a measure, as an electrolyte. More than twice as much resistance was required to produce a proper load on the generators than the computations, based on the known data concerning submerged resistances, first showed would be necessary.

Urges Convict Classification for State Road Work

G. P. Coleman, State Commissioner of Virginia, Would Assign to Highway Construction All Men Sentenced to Jail

EXPERIENCE with convict labor in Virginia has led G. P. Coleman, State highway commissioner, to make in his latest annual report several recommendations which are of interest to highway officials in the many States of the Union now using this form of labor for road work. Owing to the difficulty encountered in obtaining men from the different jails, he recommends that the various laws of the State be so amended that the convict road force can obtain the use of all men who are sent to jail.

FOUR LABOR CLASSES

Mr. Coleman would group the prison populations into four different classes as follows: Long-term and dangerous men; short-term men; trusties, and paroled men.

The first class includes all murderers and all prisoners whose records are known to be bad, and all prisoners sentenced for third offences, these men to be dressed in stripes and worked in stockades and under guard in the stone quarries and lime grinding plants of the State. The material from the stone quarries is to be supplied to the counties of the State in which there is no stone. The quarries for this purpose would be located advantageously in different sections of the State, where good transportation facilities can be utilized. Mr. Coleman feels satisfied that if this material were available for the construction of roads, the railroad companies would willingly give reduced rates. He states further that the railroad companies are now handling all material for county road work at a very low cost, thus aiding considerably in road improvement.

The second class is composed of short-term men—that is, men convicted for the first time and such men from class 1 as experience indicates can be trusted. These men would be dressed in uniforms of blue or brown and distributed throughout the State to the various road camps, to be worked under guard in the grading and actual construction of the roads.

TRUSTIES AND PAROLED MEN

The third class would be composed of trusties taken from class 2, these men to wear an ordinary khaki suit. They would be worked without guard as roller men, enginemen, cooks and yardmen in the State road camps, in small gangs to shape road and lay stone, in building concrete walls, bridges and headwalls. In every way they would be made to feel that they are in places of trust, and, above all, that they are being trusted.

Class 4, paroled men, are men to be taken from class 3 and paroled for good behavior at some period in their sentence, on the recommendation of the State highway commissioner and the superintendent of the penitentiary. These men would wear ordinary clothing and would be assigned to the maintenance department of the State and county, to be used as patrolmen on the maintenance of the roads, to be furnished with proper quarters, to be paid a monthly wage by the county for which they are working, and to be made a regular part of the State and county free labor road system, the only difference being that they shall be required to report monthly to some general head and to be governed by the parole laws of the State. Since these men would be trained in the construction of roads as prisoners it follows that they could use the knowledge thus obtained in the maintenance of the roads after construction. The State, Mr. Coleman concluded, would in this way reap a double benefit from their service. It would profit by their experience, and would give them honorable employment on the completion of their prison terms.

CONVICT CAMPS IN THIRTY COUNTIES

Virginia last year had convict labor camps in thirty counties, representing a force of approximately 1100 convicts and from 500 to 600 jail men. The cost of convict labor per 10-hour working day averaged 52.9 cents in 1914. The increase in Virginia road work is shown by the fact that only 24 miles were built by the State in 1907 and seven years after, in 1914, this mileage had increased to 855 miles. Of the latter mileage 434 miles is of a soil or sandy-clay nature and the remainder of various surfacings, macadam predominating, with a mileage of 152 miles. The State as a whole is urged by its commission to reduce the mileage and expend the difference in a higher class of construction to meet traffic conditions which obtain in many sections of Virginia.

THE DULLNESS OF THE IRON MARKET in the United States in 1914 and the consequent falling off in ore shipments from Duluth passing through the canal at Sault Ste. Marie was largely responsible for a falling off of 15,000,000 tons in the volume of traffic carried through canals in Canada last year. The tonnage through the Welland and St. Lawrence Canals increased slightly last year, but the total freight carried dropped to 37,000,000 tons—lower than that in any year since 1909.

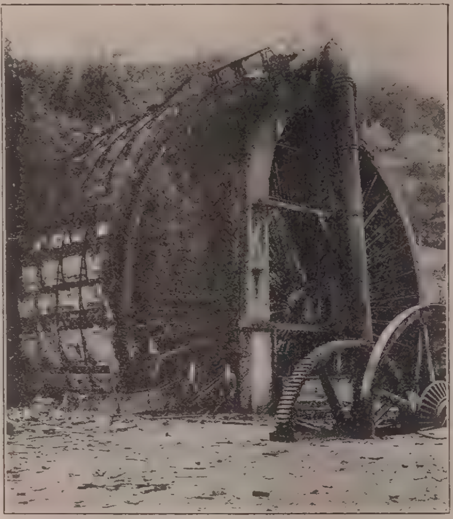
Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Old Waterwheel at Troy Ran Continuously 45 Years

SIR: Herewith is a photo of the old Burden waterwheel at Troy, N. Y. We hear many expressions of surprise that such a wheel exists, while few seem to know anything of its history and usefulness. It is a fine example of the early engineering skill and enterprise of our industrial development, not only of Troy, N. Y., where the wheel was designed and built, but of our whole country.

This large breast wheel, of the overshot type, was designed and built by the late Henry Burden in the year 1838 to operate his large rolling mills and machine shops. It was in continuous use for about 45 years, being superseded in the early eighties by a large steam plant. The wheel is 60 ft. in diameter, with buckets 22 ft. long and 6 ft. in depth. It was operated at 1½ to 2 r.p.m. and developed nearly 600 hp. The wheel or rim is constructed of approximately 175 12 x 12-in. timbers, each about 25 ft. long, the ends of which may be seen just inside the large gear. The tie-rods or spokes are of 2-in. wrought iron and secure the rim to a large built-up shaft, which consists of two large wrought-iron gudgeons secured to six cast-iron tubular struts.



A RELIC OF EARLY AMERICAN HYDRAULIC PRACTICE AT TROY

Water to operate the wheel was taken from the Wynantskill, which flows close by, by diverting it above the falls at Mill Street, several hundred feet up-stream, through an open canal along the bank back of the wheel. This canal ended at the wrought-iron distributing flume shown with the cast-iron overflow leading to the tail race at the right.

The power was distributed from a horizontal shaft extending underground, from the flywheel and spur gear, shown in the foreground, to a 3-ft. pinion driven by the large segment gear on the wheel. Another underground shaft extends at right angles from the cast-iron bevel in the foreground, operating the rolling mills, while a cable drive to the left furnished power for the machine shops, etc.

The photo was taken two years ago, and shows the splendidly preserved brick piers with their well corbeled Gothic arch at the top. For many years the brick mill buildings hid the wheel from general view. These were razed some years ago, but when workmen began to demolish the old wheel the citizens of Troy induced the present owners to permit it to stand as a monument to the skill and enterprise of Henry Burden, who established and successfully maintained for many years Troy's most important industry at that time. However, an early winter storm undermined the piers and the wheel has fallen partly over, and will soon disappear entirely, unless the citizens of Troy, or the engineering societies, undertake the rescue and preservation of this magnificent example of early American engineering skill and labor.

While the great Laxy wheel on the Isle of Man, Great Britain, is larger in diameter (70 ft.), the breast is less than one-third of, and the power developed but a small fraction of, that of the Henry Burden wheel at Troy.

E. A. VIVARTTAS,
Engineer, Ludlow Valve Manufacturing Company.
Troy, N. Y.

Public Speaking

SIR: After listening to a consulting engineer and observing how he held 500 business men of the Chicago Association of Commerce in the "hollow of his hand" for three-quarters of an hour recently, I cannot refrain from writing you to confirm the sentiment contained in your editorial on "Public Speaking Again" in the issue of May 22, page 637. The subject concerned Chicago's future sanitary policy, which most laymen, including the mayor, believed was fixed years ago when the Drainage Canal was completed. Dr. George A. Soper, the speaker, told his audience that the sanitary policy was all right so far as it went, but for some time past had been in a state of arrested development. Right there these keen business men took an extra bite on their cigars, looked at their neighbors and proceeded to occupy the forward two-thirds of their chairs. Why? Because the speaker touched the human-interest spot of pride, for every real Chicagoan never tires of telling how healthful the water supply is and how the engineers almost achieved the supernatural in reversing the flow of a river, thereby forever settling the sewerage problem.

The subject was unfolded simply and in a logical way under three heads, several times brought home from different angles but never lost sight of. Naturally, after a year's study of such an immense problem, most men, engineers particularly, get their heads too close to details to be able to stand back and with an audience survey the high points. Not once did the speaker talk "bacteria per cubic centimeter," or "oxygen consumed," yet there are few engineers who have a higher regard for statistics of this kind.

Following Dr. Soper, a politician delivered himself of a Memorial-Day oration in which he rambled along harmlessly between military unpreparedness and regulation July 4 spread-eagleism, from which the audience began to melt away long before the end. In the check-room rush for hats I strained my ears for general comment, because the tenseness of the faces during the engineer's talk indicated that he had "rung the bell," as they say out West. The orator was ridiculed and the sanitary engineer was commended. His arguments were retained and it is my belief that filters for Chicago water are a year nearer because of his talk. But best of all, Chicago business men have a clear understanding of one of the big problems of the city and an increased respect for the engineer and his problems.

As my engineer friend to the left remarked, the greatest problem of our profession to-day is to supply a means whereby the engineer can get his work before the public in a dignified manner. A golden opportunity exists, said he, for the Western Society of Engineers to hire a man whose whole occupation it is to get proper publicity for engineering matters. My conclusion is that every engineering society ought to dispense with some of the useless reading of papers printed in advance and to take up the time in self-inspection for a few evenings. A way must be found to develop the latent talent in the younger generation, even if it is necessary to form old-fashioned debating-society sections with the senior members as mentors.

Chicago. INTER NOS.

Is Exactness in the Analysis of Conduits Justifiable?

SIR: The writer was interested in W. M. Smith's article on the least-work analysis of a reinforced-concrete conduit appearing in your issue of May 22, page 648, which is based on the method explained by him in the issue of Oct. 10, 1914. The analysis of a reinforced-concrete arch bridge with an earth fill is acknowledged by all to be rather uncertain, because of the indeterminate distribution of loads through the fill. That our knowledge of earth pressure is very elementary is witnessed by the difficulties presented by the design of a simple retaining wall. In view of these facts, it does not seem that the earth pressures exerted on a conduit in a deep fill can be estimated with any degree of accuracy which would justify an accurate analysis for an assumed condition of loading.

Assuming in this case that an accurate analysis is desirable, the theory of elasticity furnishes the only solution and Mr. Smith's method is unique and excellent so far as its practical accuracy is concerned, but it only serves to increase the impression of the irony of the term "least work." The writer was impressed by the amount of labor involved in the analysis of elastic arches, both two hinged and fixed, and some time ago became convinced that the application of the very simple theory involved could be greatly simplified. He has since made an investigation of the theories of least work and virtual displacements and has discovered a general graphical method for the solution of elastic arches or frames by which the influence lines for the reactions at the ends of any fixed concrete arch produced by a concentrated load moving over it can be found accurately and easily in less than half a day by one man. On further investigation, he found that this method is known in Europe but has not been taught in this country or used to any extent by American engineers, because they are not familiar with it. It affords a very simple solution of the problem which Mr. Smith has so ably solved by a longer process.

Ithaca, N. Y. C. S. WHITNEY, C. E.

[A copy of Mr. Whitney's letter was sent to Mr. Smith, the author of the article in question, whose reply follows.—EDITOR.]

SIR: The writer has read with interest Mr. Whitney's criticism of his article on "Arched Reinforced-Concrete Conduits Designed by the Theory of Least Work."

It seems rather unfair, does it not, to assume that because the external loads cannot be determined exactly, that the process is not worth while? The writer is perfectly willing to admit that for small, unimportant culverts or conduits where a failure would not do a great deal of harm nor cause any loss of life, the process is not worth while, but for conduits costing more than $100,000 each, the sudden failure of which would probably cause the loss of hundreds of lives, and certainly that of millions of dollars' worth of property, the process is most certainly worth while.

Of course the reaction of the foundation material is somewhat uncertain, but it can be determined with a reasonable degree of accuracy when the supporting power has been found; then by designing the conduit to be safe for extreme probable limits one can feel sure of his design. The loads on the arch can be determined between narrow limits. The writer has records of about 450 experiments to determine the ratio of horizontal to vertical pressures in earth embankments of all kinds of materials. Saturated materials gave a maximum of 42 per cent and a minimum of 40 per cent. Excluding moist sand and very hard dry clay, the non-saturated materials gave a maximum of 37 per cent and a minimum of 26 per cent. The vertical load can be found very closely when the kind of material and method of construction are known, hence the loading of the arch can be determined between narrow limits.

Mr. Whitney seems somewhat appalled at the amount of work involved in the process. The writer would therefore like to give the following example of the rapidity with which the work may be done. One of his assistants has just completed an investigation of one of the conduits for the Dayton flood-prevention work. On account of the great difference in the load on the conduit at the center of the dam and at the ends of the conduit, several different sections were necessary. Twenty different investigations of the arch were made, temperature stresses being computed and combined with load stresses. Inked diagrams were made of all the investigations, and a summary sheet tracing was made showing the resulting stresses. The total time of the one man on the entire work was 23½ days. That does not seem very appalling.

The writer wishes to state that where the load on an arch is very unsymmetrical an additional step to those shown for the fixed arch in his article in the Engineering Record of Oct. 10, 1914, is necessary. After the horizontal component of the true crown thrust and its point of application have been obtained as shown in that article, the additional step is needed to determine the true vertical component of the crown thrust. This is done by drawing three or four pressure lines with crown thrusts which have the same horizontal component and the same point of application, but each with a different vertical component. When a minimum value has been obtained it gives the true vertical component. Of course this step is not needed when the load is symmetrical on the fixed arch, and is not needed at all on the two-hinged arch. It will generally not take more than three hours in the average arch.

While this method of designing a masonry conduit may not be the shortest nor the most accurate that can be developed it is the best that the writer has found in his long experience and if Mr. Whitney has a method that is equally accurate and much shorter he will certainly confer a great benefit on the engineering profession by publishing it, and the writer for one will be very glad to see it.

WALTER M. SMITH, C.E.

Dayton, Ohio.

Illinois Civil Service Eligibility

SIR: On page 695 of your issue of May 29 appears a statement so misleading, even though it be unintentional, that comment appears necessary. From your statement the inference may be drawn that improper standards are being set up by the Illinois Civil Service Commission in announcing examinations for certain positions in the engineering service of the Illinois Civil Service Commission in announcing examinations for certain positions in the engineering service of the Illinois Public Utilities Commission.

The bars are not "let down for three of the positions," as stated. All of these examinations are open to any male resident of Illinois, absolutely regardless of how far he went in his schooling. The statements given out from this office as to educational requirements mean only that it is felt that applicants with less schooling then indicated will have slight chance to qualify. With regard to the three positions named, telephone engineer, gas engineer and railroad engineer, the Civil Service Commission felt that there would probably be numerous applicants who might have had long practical experience but who would probably have obtained this experience without having had college training. There are many men in such lines who have gained practically all their technical education while working on the job. It would be wrong to discourage these men, even though the college-trained man will have the advantage finally, other things being equal.

You will see, therefore, that these "requirements" are suggestive rather than mandatory. The examiners will take all education into consideration, regardless of the announcements referred to.

As this group of positions constitutes an important addition to the engineering public service, I believe it will interest your readers to know the plan of examination which has been determined upon. The inquiry into the merits of the applicants will not be by the usual written examination, but will be of the "unassembled" type. Questions relating to education and experience will be mailed to all applicants at their homes. They will send their replies to this office, where they will be checked over by a competent board of engineers who are not in any way connected with the State service. Those who appear to be fitted for the positions sought will be later called before the same examiners for a supplementary oral interview, which will afford an opportunity to judge of the personality of the applicant. This method practically duplicates the employment methods of any railroad or corporation in that it consists of an inquiry into education, training, experience, personality and reputation, and does not include a written test on technical matters.

The above, I believe, will make it evident that differences in amount of schooling will, in the final analysis, cut little figure in determining an applicant's standing. The important items are his practical experience and reputation as an engineer.

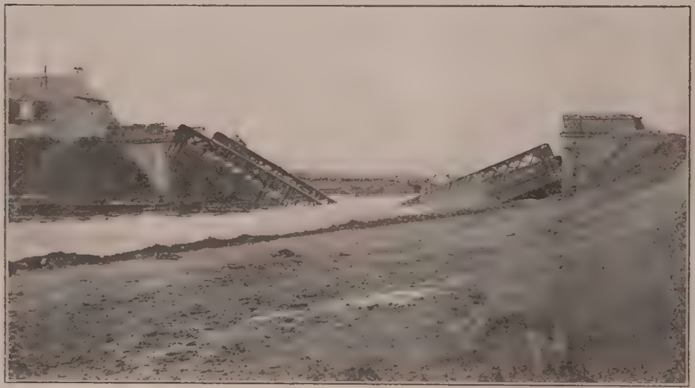
STATE CIVIL SERVICE COMMISSION,
W. R. Robinson, Secretary.
Springfield, Ill.

Two Bridges in the War Zone

SIR: I am enclosing herewith two pictures taken in the war zone. The broken span is over the Aisne Canal between Soissons and Berry-au Bac. It was struck by a German shell a few weeks ago.

The other bridge is across the Aisne River, not far from Craonne. It was built by the French engineers to replace the pontoon. The driver used for setting the piles was worked by hand—twenty men on the rope.

France. F. W. ZINN.



AT LEFT — BRIDGE OVER AISNE CANAL IN FRANCE BLOWN UP BY FIGHTING TROOPS

AT RIGHT — ARMY-BUILT BRIDGE IN FRANCE TO REPLACE PONTOON OVER AISNE RIVER

Length of Life of Walls of Mortar on Metal Lath

SIR: In your issue of May 22, page 660, J. C. Crouse asks for a general expression of experience with regard to the life of outside building walls of Portland cement mortar plastered on metal lath. The experience of the writer is that the life of this type of construction depends entirely on the manner in which the work is done and that there is one essential ingredient which must always be present—an active conscience on the part of both the designer and builder.

The metal lath would have an indefinite life, as we know, if it could be entirely protected from the action of the elements. The Portland cement mortar would also have an indefinite life if the mixture were sufficiently dense and the surfaces so treated as to exclude moisture. The usual method of application falls far short of protecting either the mortar or the metal lath and consequently is likely to be short-lived. The mortar is often "buttered" on to the lath in a thin layer which is not pushed through the lath any more than just sufficient to hold it on, with no thought of the protection of the back of the lath. Where it is possible to plaster both the inside and outside of the lath a good protective coat can be secured, but where it can be plastered only on the outside it is very difficult to protect the back side of the lath, and consequently the writer would always specify a galvanized lath for exterior work plastered one side. Some moisture is bound to get behind the mortar in spite of the use of building paper and flashing.

A dense mixture of mortar should be used and the surface should never be left in a porous condition but should always be waterproof. A common and satisfactory way of waterproofing is to give a splash finish with cement grout after the mortar has been given time to set—say about 24 hours. It is necessary that the mortar be protected from freezing until thoroughly set and it is best to avoid doing work of this kind where the temperature is below freezing, as the mortar will certainly come off otherwise.

The writer has in mind a dwelling house near Newark, N. J., where the mortar was placed during freezing weather in February. Large patches of mortar fell within 6 months and it was necessary to renew the work within a year. The metal lath, being unprotected, rusted away entirely so that no trace remained except streaks of rust on the back of the fallen patches. On another building nearby where the mortar was of proper consistency and had proper surface treatment but did not cover the back of the lath the wall stayed up for about 5 years and then, becoming cracked, fell off in large slabs. So little evidence of the metal was left that it was hard to distinguish even the type of lath which had been used. The stucco should not be carried nearer than 18 in. from the ground on account of the danger from splashing.

Many architects are now specifying wood lath for exterior dwelling house work of this nature but it is the opinion of the writer that with metal lath a life of 20 years or more can easily be obtained by the use of proper precautions. Without these precautions being taken the work should not be done.

Washington, D. C. W. E. BELCHER.

Simple Solution of a Quadratic Equation by Slide Rule

SIR: In the different branches of engineering practice quadratic equations must often be solved. This is usually done by means of the formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

When the slide rule is used, this method consists of several operations, and is inconvenient and subject to numerical errors of various kinds. I have discovered the following simple method of solving quadratic equations on the slide rule, which appears to have decided advantages over the usual one in that it saves time and does away with practically all liability of numerical error.

Any quadratic can be reduced to the form

$$x^2 + bx + c = 0$$

in which b and c might be any positive or negative real numbers. Numbers satisfying the following two conditions are the roots desired: (1) Their product must equal c and (2) their algebraic sum must equal b.

Set the hair line of the runner over c on the D scale. As a result of this setting of the hair line, the produce of the reading of the hair line on the C scale and the reading of the left or right index on the D scale is always equal to c for any position of the slide. These two readings therefore satisfy the first condition. By moving the slide and adding the readings on the C and D scales mentally the slide can be set at a position where the algebraic sum of the readings will equal b. These readings, then, satisfy both conditions and are the roots of the equation.

As an example, take the equation

$$x^2 + 3.97x + 3.85 = 0$$

Set the hair line over 3.85 on the D scale. When the left index of the slide reads 1.5 on the D scale, the hair-line reading on the C scale is 2.565, their sum being 4.065. When the index reads 1.9, the hair line reads 2.025, and the sum is 3.925. The first sum is greater and the second is less than b, which should be 3.97. The proper position of the slide index must therefore be between the two. Moving the slide back toward the first position and watching the variation in the sum of the two readings, we come to the index setting of 1.68 on the D scale and the hair-line reading of 2.29 on the C scale, their sum being 3.97 or b. That these are the two roots of the above equation can easily be verified. It is obvious that the signs of these roots are both negative.

Brooklyn. SAUL SHAW.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Light Traveling Elevator Facilitates Concreting on Building Work

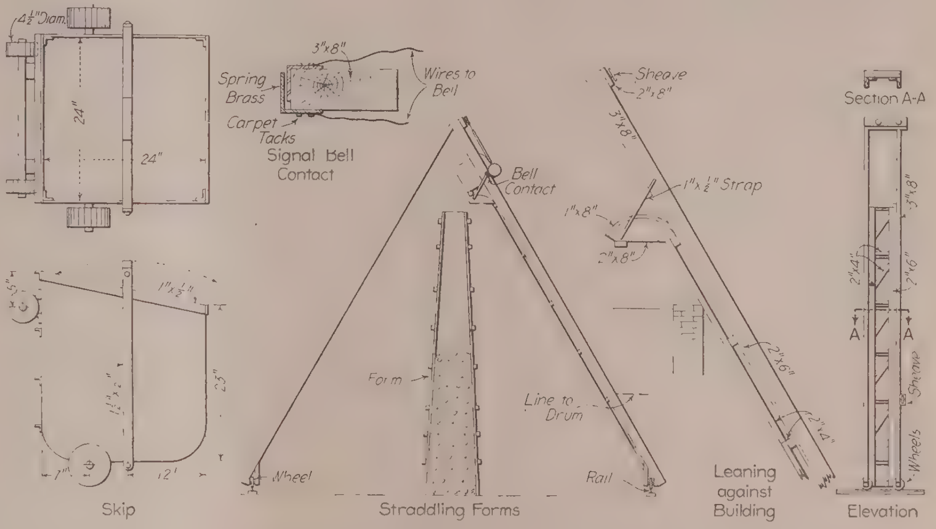
By ROBERT SHANNON

Of J. H. & R. Shannon Company, Jersey City, N. J.

THE LIGHT traveling bucket elevator illustrated herewith, which was designed and built by the J. H. & R. Shannon Company, has cheapened by 40 to 50 cents per cubic yard the cost of placing relatively small volumes of concrete in piers and floors of building work. This saving per cubic yard is over the cost of doing similar work with a distributing system depending on a tower elevator. A complete elevator of this kind, including the skip, has been built for less than the cost of the average tower alone of the same height. One of these towers, 35 ft. high, has been set up and material handled on it 45 min. from the time it arrived on the job. The elevator is rolled along on a track beside the wall, floor or pier forms into which it is delivering, saving wheeling materials on long runs. It is built in 12-ft. spliced sections, and can be easily knocked down and taken to another contract or to another part of the job. The one illustrated has a 5-cu. ft. skip, and was used with a portable mixer mounted on a truck which discharged directly into the skip. The concrete mixer, made by the American Cement Machinery Company, was built with a special hoist added to it for the purpose of hoisting lumber and forms, as well as concrete, so that it is a combined mixer and hoist.

ELEVATOR IN USE, LEANING AGAINST BUILDING, AND MIXER-HOIST

A separate gasoline hoist, however, may be used with this elevator, and it or the mixer or both moved only at intervals. In this event concrete may be carried to the skip in carts. On one job where the line needed to reach the extreme position of the elevator was too long to be coiled on the drum of the hoist when the elevator was near by, the end of the rope was coiled up and clamped above the bail of the bucket.



THIS ELEVATOR HAS BEEN SET UP AND STARTED RUNNING FORTY-FIVE MINUTES AFTER ARRIVING ON THE JOB

Where the elevator is moved and the hoist remains stationary, it is impossible to mark the cable so the engineer can tell when the skip is in a dumping position. Neither is it always possible for the engineer to see the skip in this position. In place of having the ordinary bell, pulled with a wire by some one on top of the form, an electric contact device mounted on the guides on which the bottom wheels of the skip run rings a signal at the hoist when the skip reaches the dumping position, and charges its load. This device, made of a brass spring and contact fastened on with carpet tacks, is shown in the accompanying drawing.

The elevator is shown arranged as an A-frame straddling a series of pier forms or a wall form in the drawing. It may also be used without the back legs and the second track by leaning it against the form work or against the site of the building. As it is very light, it is easy for one or two men in the latter case to hold it out from the building while it is being rolled along the track. It may also be held out from the building by a guy line attached to its top. The elevator has been used in the construction of the Danforth Theatre, a swimming pool known as the Peoples Palace and several other buildings in Jersey City.

Safety-First Measure Used in Handling Hot Rivets Over Streets

IN riveting steelwork on the Manhattan elevated railway lines the spectacular method of tossing the red hot pieces of metal from the forge to the men on the staging above had to be abandoned because of the possibility of injury to people and vehicles in the densely traveled city streets. One safety-first plan adopted involved the use of two old galvanized pails, one on each end of a rope which passed around a sheave hung from one of the elevated girders. A hot rivet, placed in the bottom pail at the street surface, was raised by pulling the rope, while the empty pail on the other end of the line descended to the level of the forge. At different points on the work, even old tin cans have been pressed into service. Where there is room for the forges above ground, they are usually set up on top of the steelwork, either on a solid plank deck or over heavy wire netting. A freshly heated rivet was then placed in the latter and the operation repeated.

Pipe Pontoon Used for Reclaiming Pipe Line in Bed of Ottawa River

THE PIPE LINE from the pumping station which supplies the city of Ottawa, which was laid over 25 years ago in the bed of the Ottawa River, has been raised, repaired, tested and replaced by unusual methods involving the use of a pontoon, made of pipe, and capable of lifting 13 tons. The work of replacing the 3000-ft. section was described recently by L. McLaren Hunter, of the city engineer's department of Ottawa, before the Institution of Municipal and County Engineers of Great Britain.

The pipes on this river section averaged 50-ft. long, and had been covered with bark and logs to a depth of 3 to 4 ft. Owing to this fact it was found impossible to use the ordinary floats or scows for lifting and taking the pipe ashore. This difficulty was overcome by putting bulkheads on two lengths of pipe, and erecting gantry frames between them, one at each end, forming a 40-ft. pontoon. On each gantry was mounted a windlass for raising the sections of the old line. The pipes were spaced 15-ft. apart, and their flotation gave a lifting capacity of approximately 13 tons. When this float was carried out over the old pipe divers disconnected the old line in sections and slung a chain around each piece. The pipes were then raised by the windlasses and a bulkhead put on each end. The sections were floated to shore where a temporary repair yard had been fitted out, and were there repaired and tested.

All calking and riveting was done by compressed air. Four of the sections taken from the river were connected by alternate plain and flexible corrugated sleeves, giving an approximate length of 200 ft. Curved flanges were riveted on each end, and the pipe tested to a pressure equal to twice the working head. These 200-ft. sections were then launched, floated back to place and sunk. All under-water connections were made by divers. The buoyancy of this section of the pipe line is overcome by sinking wooden cribs loaded with stone on top of the line.

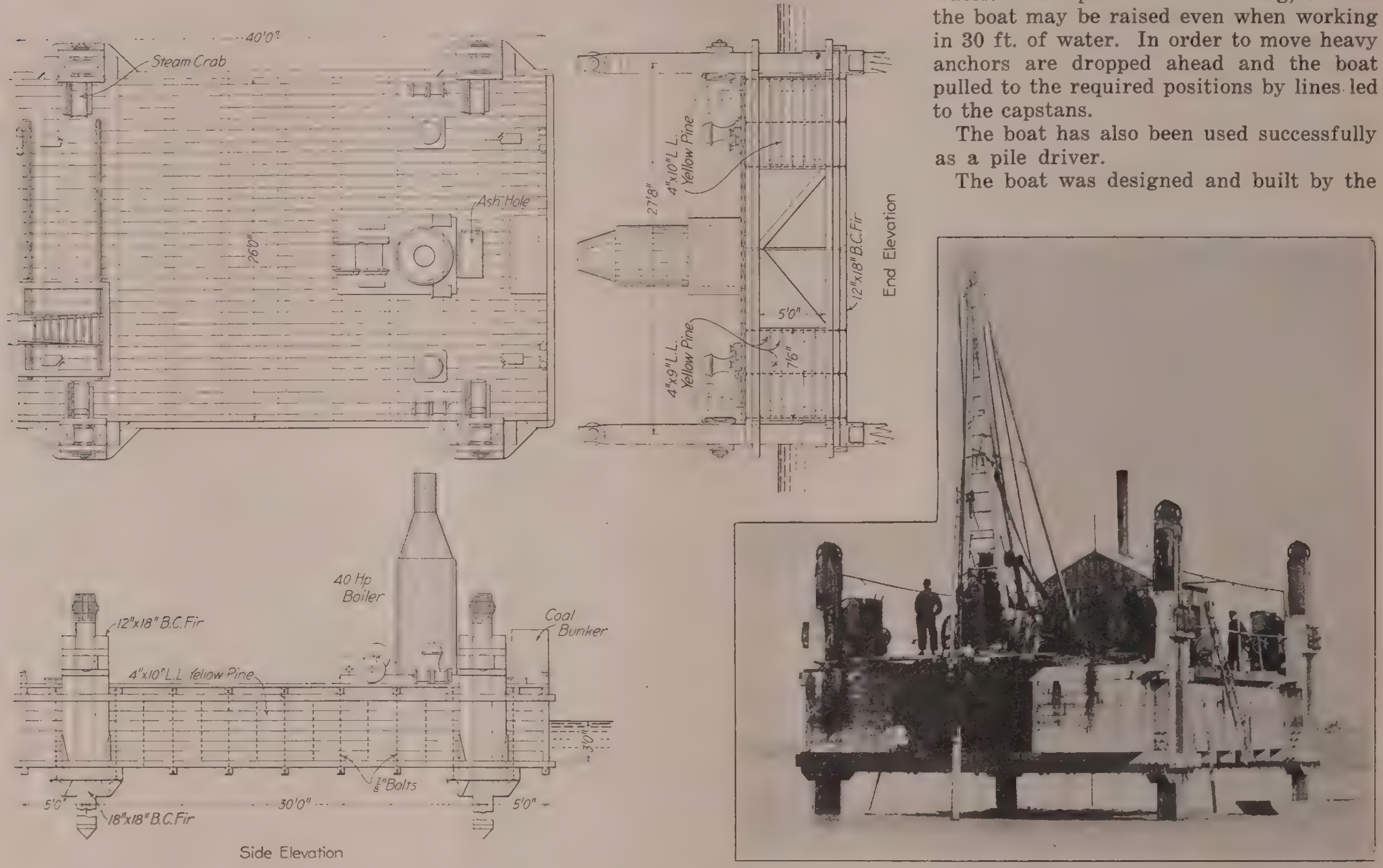
Portable Wooden Sheds Protect Men Engaged in Mudcapping

ON WORK where a great deal of block holing and mud tamping is going on, portable wooden shelters for the men will save a great deal of time, according to the "DuPont Magazine." These are usually built about 5 ft. high and 3 ft. square, with one open side, and have a roof made of 2-in. plank. When two or three such shelters are scattered over the work, and moved as necessary, the men engaged in drilling in the neighborhood do not have to run to a distance every time a light shot is put off.

Drill Boat Lifts Itself Out of the Water to Escape Waves

By W. B. MACDONALD
Mechanical Engineer, Welland Ship Canal

AT the Lake Ontario end of the Welland Ship Canal there is no natural harbor and all work at the entrance is exposed to the full force of lake storms. To obtain quick and accurate rock soundings, a drill boat was required which would be light and easily handled and, at the same time, give a safe and steady working platform under all weather conditions.



THIS BOAT, BY RAISING ITSELF CLEAR OF ROUGH WATER, FORMS A STEADY PLATFORM FROM WHICH TO CARRY ON DRILLING OPERATIONS

The boat is formed of twin hulls, which give the required flotation, and also act as beams to carry the weight when the boat is raised clear of the wave-action. The twin hulls are secured together and rest on four deep wooden beams, two at each end. The hulls are spaced to give the required deck room.

The drill boat is raised on four heavy spuds or anchors, one at each corner, by means of four 10-hp double crabs and a four-purchase wire-rope system. The raising rope is led from the top drum of the steam crab, over the sheaves on top of the spuds, to a sheave outboard of guides, and back inboard. To lift the spuds during flotation a rope runs from outboard of guides, through a sheave led into the base of the spud, and then to lower drum on the crab. The two drums are sized so that ropes are always taut.

The raising engines are secured to the spud-guides, which, in turn, are securely fastened, by means of strong cast-steel brackets, to the deep wooden beams under the hulls.

The working platform is carried on wooden beams laid across the tops of the twin hulls. This platform is 40 x 26 ft. and on it are placed a drill outfit, two 7½-hp capstans for handling the boat, four hoisting engines, and one upright steam boiler, supplying steam for all purposes.

The drill hole is started in the usual way until rock is nearly reached, then cores are taken, casing being used.

In rough weather, when the weight of the boat on the spuds is insufficient to prevent it from lifting from the force of the waves, the boat is raised 4 or 5 ft. clear of the water. The spuds are 45 ft. long, so that the boat may be raised even when working in 30 ft. of water. In order to move heavy anchors are dropped ahead and the boat pulled to the required positions by lines led to the capstans.

The boat has also been used successfully as a pile driver.

The boat was designed and built by the writer under the direction of J. L. Weller, engineer-in-charge, Welland Ship Canal.

Hydrated Lime Causes Easy Flow of Grout for Tunnel Lining

HYDRATED lime was used in the grout for sealing the back of tunnel lining in driving the sewage tunnel under the Kaiser Wilhelm Canal at Kiel, in order to make the mixture flow easily. The tunnel was driven under compressed air by the shield method and is lined with segments made from rolled shapes. After the sections are in place grout is forced back of the lining under a pressure of 15 to 23 lb. to the square inch.

Since a mixture of cement and tufa alone does not flow readily, experiments were made with mixtures containing different proportions of hydrated lime. As a result it was found that satisfactory results could be secured with a mixture of 1 part cement, ½ part tufa, ½ part of hydrated lime and 3 parts of sand, and this mixture was used throughout the work.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Worcester Polytechnic Celebrates Fiftieth Anniversary

Distinguished Guests, Representing National Technical Societies and Colleges, Are Present at the Ceremonies

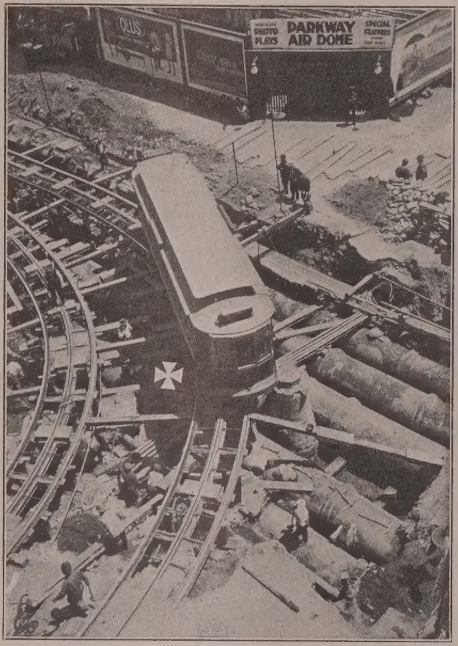
The fiftieth anniversary of the founding of Worcester Polytechnic Institute was celebrated June 9, with a distinguished company of guests representing National technical societies and engineering colleges from coast to coast in attendance. The principal meeting was marked by scholarly addresses by Ira N. Hollis, president of the Institute, and President Lowell of Harvard. John A. Brashear, president of the American Society of Mechanical Engineers, spoke in his usual happy mood. Booker T. Washington pointed out the relation of all serious educational work, whether primary or advanced, while Governor Walsh of Massachusetts brought the greetings of the Commonwealth.

The banquet in the evening was an even more brilliant affair, with exceptionally able addresses by Howard Elliott, president of the New York, New Haven & Hartford Railroad, and Major-General Leonard Wood of the U. S. Army. Mr. Elliott pointed out the part that engineers should play in spreading sound doctrines concerning corporations and regulatory work, while General Wood advocated a small standing army, but thorough preparedness by having a large trained citizen soldiery and a classification and marshalling of resources such as is represented by engineers and graduates of colleges and universities, particularly of those having military drill. Senator Weeks pointed out the value of technical training, no matter what a man's vocation, while Arthur D. Little, of Boston, in an address of rare literary finish, reviewed the progress in industrial research during the fifty years of the Institute's life.

Prospective Laws Force American Society Vote on Licensing

A vote is to be taken in the American Society of Civil Engineers, and canvassed Aug. 31, to help in determining the attitude to be adopted by the society in connection with the licensing of engineers. The point to be decided is whether the action of the society at its annual meeting in 1911, "that it is the sense of this meeting that the licensing of engineers by States is undesirable," should be rescinded.

In an explanatory circular sent out by Charles Warren Hunt, secretary, it is pointed out that existing conditions may lead to the enactment of State laws controlling the practice of engineers, that laws for licensing engineers have been enacted in three States and urged in ten others, and that laws for licensing architects have been passed in seven States and proposed in seven others, which place the structural engineer at a disadvantage. The six leading engineering societies have created a joint committee to prepare a draft of a registration act least objectionable to engineering interests, and this committee has made a report. In view, however, of the above-mentioned action taken by the American Society of Civil Engineers in 1911, the board of direction does not feel free to proceed as occasion may demand, and has therefore submitted to the society at large the question of rescinding the previous action. The board recommends that it be rescinded.



FOLLOWING BREAK ALL FIVE MAINS WILL BE SUPPORTED BY NEW FOUNDATION
Break occurred at X.

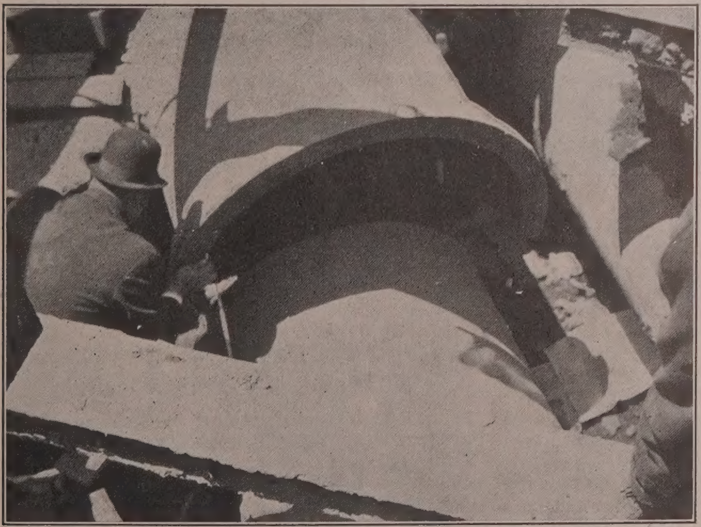
Forty-Eight Inch Cast-Iron Pipe Breaks in New York

One of Five Large Croton Supply Feeders to Central Park Reservoir Is Ruptured by Settlement of Rock-Filled Ground

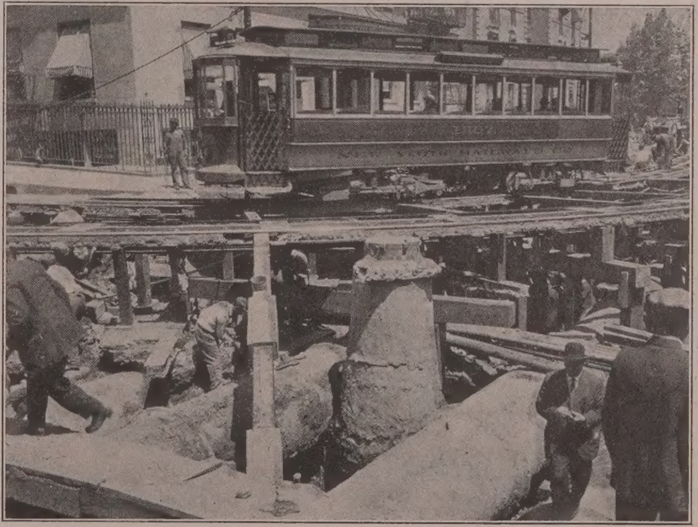
Settlement of the rock-filled area in which it was laid 27 years ago is the cause ascribed by Commander A. B. Fry, consulting engineer of the New York Department of Water Supply, Gas and Electricity, for the break which occurred, on the night of June 3, in a 48-in. cast-iron pipe line of the Croton aqueduct system, located at 109th Street and Manhattan Avenue. An unusual feature of the accident was the fact that comparatively little water rose to the street surface. Apparently the bulk of the flow from the broken main passed off through the interstices of the rock-filled ground and possibly into a large sewer in the vicinity, although part of the discharge made its appearance more than a block away at the 110th Street elevated railway station, putting the passenger elevators out of commission.

The main is one of eight 48-in. cast-iron lines from the Croton aqueduct terminal gatehouse at 135th Street and Convent Avenue. Five of them extend under Manhattan Avenue, four leading to the reservoir in Central Park. The work formed Section 16 of the Croton aqueduct contract awarded on May 16, 1888 to O'Brien & Clark for $1,030,215.

The lines are laid in a blanket of earth upon a rock fill 35 ft. deep, and it is believed that a leak from the 48-in. line, or from a nearby 6-in. pipe line, undermined the big conduit and allowed it to sag down and break as the ground supporting it settled. In fact, precisely this condition was discovered some time ago by Henry B. Machen, borough engineer, at 110th Street where, luckily, the settlement of the street surface indicated the danger before the joint pulled out and did any damage. At this place a settlement of 19 in. in the pipe line had occurred.



WHERE THE TROUBLE STARTED—SETTLING GROUND IN ROCK FILL RUPTURED 48-INCH PIPE LINE OF NEW YORK'S CROTON SUPPLY



REPAIR WORK NECESSITATES TRACK SUPPORT OVER CONGESTED SUBSURFACE STRUCTURES AT POINT OF RUPTURE

The break occurred directly below the point where the street car tracks form a curve between 109th Street and Manhattan Avenue. An examination of the cavity opened up by the water department's forces shows that the five parallel 48-in. pipe lines at this place are separated, one from another by masonry walls, which serve the double purpose of isolating the lines and supporting the street railway structure. In addition, longitudinal and transverse I-beams help to carry the tracks over the pipes. In view of this condition of support the belief is that the impact of passing cars could not well have been transmitted to the large cast-iron main, causing its rupture, as was the case with the break at Eighth Avenue and 42nd Street last winter, as reported in the Engineering Record of Feb. 6, page 183. Settlement of the filled ground is advanced as the most plausible reason for the accident.

The pavement in the vicinity, consisting of sheet asphalt, asphalt block and granite block between the car tracks, is carried on a thick foundation of concrete which undoubtedly served as a blanket in restraining the flow up to the street surface. Nevertheless, there is a notable subsidence of the asphalt pavement for a short distance at the street intersection.

The fact that the five pipe lines were separated by masonry walls undoubtedly prevented the undermining and breakage of more than one of the conduits. The pipes carry a gravity flow and the pressure at the time was about 35 to 40 lb. per square inch.

William W. Brush, deputy chief engineer of the water department, estimates that the break released a flow at the rate of approximately 50,000,000 gal. per day. Mr. Machen was at the site shortly after the accident occurred and directed the work of repair. All of the hand-operated valves on the five 48-in. lines were shut down at the 135th Street gatehouse as soon as the news of the accident was received. No direct water shortage resulted from the rupture of the line, for it is not connected to the distributing mains but acts as a feeder to the reservoir in Central Park. It is predicted that the accident will result in the substitution of electrical control over the gatehouse valves at 135th Street, in place of the hand operated equipment now installed.

Another important sequel to the accident is the decision to place a foundation under all of the five pipe lines for a block or so in Manhattan Avenue. The street is lined with apartment buildings and the undermining of the foundations of these structures, due to another break, would probably be attended with serious consequences. The street has already been opened up, and, while none of the other lines has broken, serious sagging at joints has been noted in several places. With a supporting structure under the big conduits, however, no further trouble is anticipated.

To Appoint Committee on Standard Specifications for Hollow Tile

On the basis of a recent report submitted by the temporary committee appointed to report on the advisability of appointing a permanent committee on standard specifications for hollow building tile, and as to the need of funds for such investigations and the probability of obtaining them from the commercial interests affected, the executive committee of the American Society for Testing Materials has authorized the creation of such a permanent committee. A committee has been appointed on standard specifications for gypsum and gypsum products.

Recommend Single Department for Illinois Public Works

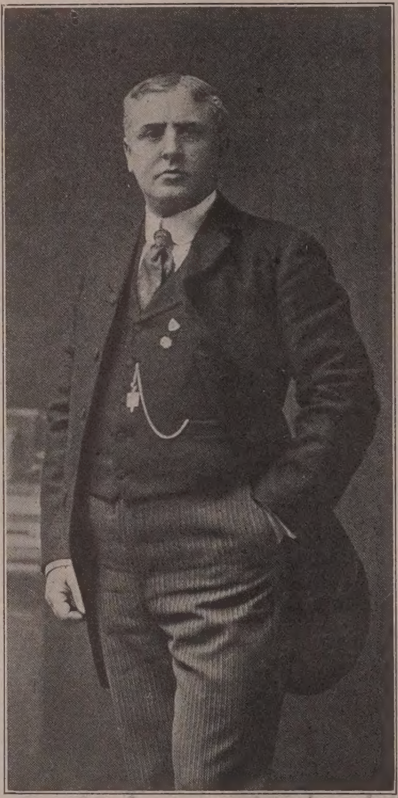
The Efficiency and Economy Committee of the State of Illinois recommends in its report that the existing State authorities having jurisdiction over highways, public waters, fish and game conservation, State parks, and building construction and maintenance be combined into a single executive department of Public Works, Parks and Buildings. It proposes that the department be placed under the general supervision of a salaried commission of three members, to be appointed by the Governor with the consent of the Senate.

It further proposes that one of the members of the Public Works Commission shall be State highway commissioner, one commissioner of waterways and the third fish and game commissioner, each of whom will be in direct charge of one of the main divisions of the department, the commissioner of waterways combining the functions of the Rivers and Lakes Commission and the Canal Commission.

Austin Lord Bowman Dead

Austin Lord Bowman, chief engineer of the Department of Bridges, City of New York, died in New York, June 3. He was graduated from Yale University in 1883 and for the first few years was engaged principally in railroad work. Then he was appointed engineer and superintendent of construction for the American Bridge & Iron Company, of Roanoke, Va., and later was in the service of the U. S. Government, in charge of building the snag-boat, Roanoke, and removing two large schooners sunk in 80 ft. of water at Hampton Roads, Va. In 1897 he engaged in private practice as consulting engineer, specializing in bridges and heavy construction work, and directed the reconstruction of a number of the bridges of the Central Railroad of New Jersey. In 1907 the New York Department of Bridges made a complete investigation of the traffic-carrying capacity of the Queensboro bridge under his direction, and the report which was prepared as a result was used as the basis of the department's plan for the arrangement of the structure to accommodate the operation of the dual subway system. He also directed a similar work in connection with the Williamsburg bridge, which resulted in the strengthening of that structure to accommodate railway traffic which was not considered in the original design. In addition he had much to do with the construction of the Manhattan bridge and with the maintenance of the old Brooklyn bridge. He was appointed chief engineer of the bridge department in July, 1914.

By His Death Last Week the New York Department of Bridges Loses Its Chief Engineer



AUSTIN LORD BOWMAN

Robert Ridgway Receives Honorary Engineering Degree

In recognition of his notable service to the City of New York in the construction of her most important engineering works, including the Croton aqueduct, the existing subway system, the Catskill aqueduct and the new subways now under contract, New York University this week conferred upon Robert Ridgway, engineer of subway construction for the Public Service Commission, the honorary degree of Master of Science in Civil Engineering. Mr. Ridgway was the only engineer thus honored at this year's commencement exercises and is the fifth engineer whose achievements New York University has recognized.

As first deputy to Alfred Craven, chief engineer of the New York subways, Mr. Ridgway's duties call for an executive of unusually broad experience in the construction of engineering works on a huge scale. His previous work on the Catskill aqueduct, where he served under J. Waldo Smith as department engineer of the northern aqueduct department, qualified him for any post of large responsibilities, for he had charge, among other works, of the spectacular Hudson River siphon, the pressure tunnel which carries the aqueduct flow underneath the river at a depth of almost a quarter of a mile, the Rondout, the Wallkill and the Moodna pressure tunnels, many miles of open cut work and a number of steel pipe siphons.

Mr. Ridgway was born in Brooklyn in 1862 and entered the service of the City of New York in 1884, joining the engineering staff of the Croton Aqueduct Commission. He was in charge of construction on the Titicus dam and the Jerome Park reservoir. In 1900 he was appointed to the Rapid Transit Commission and, as division engineer, directed work on the East River tunnels and subway construction in Brooklyn. Mr. Ridgway enjoys the unusual distinction of having served the City of New York, in an engineering capacity, for a continuous period of 31 years. He is a past-president of the Municipal Engineers of New York and a director of the American Society of Civil Engineers.

In presenting the diploma Chancellor Brown said:

"Robert Ridgway, distinguished for public service as an engineer, particularly in the construction of great aqueducts and rapid transit lines, honored and beloved by your professional associates and by a wide circle of our citizens, by virtue of the authority of this university, committed to me, I welcome you to the degree of Master of Science in Civil Engineering, with all of the rights and privileges appertaining to that degree, whereof this diploma shall be the evidence."

Chicago Railway Terminal Commission Makes Recommendations

Eleven or more general recommendations are made by the Chicago Railway Terminal Commission, of which John F. Wallace is chairman, in a preliminary report submitted last week to the Chicago council committee on railway terminals. The report is based on investigations of Chicago's railway terminal situation, made since the formation of the commission May 25, 1914. In addition to the Chicago situation, the commission has set forth in its report an account of its personal examination on the ground of the terminals at Toronto, Montreal, Boston, New York, Liverpool, Manchester, London, Paris, Brussels and Antwerp.

The recommendations in brief are as follows:

Readjustment and simplification of existing railroad terminals by combination and cooperation.

Application of through routing principle to Chicago suburban service.

Simplification and regrouping of present superficially spread-out competitive freight terminals within congested area.

Straightening of the south branch of the Chicago River, so that railroad properties now cut off by the river can be made available for intensive development.

Prohibition of the handling of carload freight within the congested area.

Interchange of less than carload freight on general principles similar to those applied at Clearing Yard, Chicago.

Prohibition in general of the sorting or loading of outbound less than car-load freight at freight terminals in the congested area.

Where outbound less than car-load freight is brought by teams or trucks to freight stations or team tracks within the congested area, loading of it as directly as practicable from the vehicles into trap cars.

Establishment of outlying less than carload clearing stations or yards.

Construction of three union co-operative clearing stations or yards, located in different sections of the outlying portions of Chicago.

Establishment of universal freight stations at appropriate points in the central terminal area.

Taking to outlying clearing yards of all the roads, or of the roads of one of the groups—depending on the system—freight received at universal stations, and then sorting and transferring this freight and loading it to its destination. In event that this last service is found to involve extra expense to the railroads over the cost to them of handling freight teamed to their respective individual receiving stations, the shipper utilizing these stations is to pay an appropriate charge for the privilege which enables him to reduce costs and delays in teaming.

THE MCGRAW PUBLISHING COMPANY INVITES ENGINEERING RECORD READERS TO MAKE ITS EXPOSITION BOOTH AT SAN FRANCISCO THEIR HEADQUARTERS

First Quarter of Chicago's Clearing Yard Has Been Opened

One quarter of Chicago's reconstructed clearing yard, which was described in this journal, Sept. 12, 1914, page 176, was put in operation June 3. Another quarter will be opened up this week and so on until the yard is in full operation. The Chicago & Western Indiana Railroad is the only road using the yard at present. The gradual opening of the yard is made in order to get men broken in to the operating work.

Record's Exposition Booth at Service of Its Readers

To engineers who are planning a trip to the Panama-Pacific Exposition in San Francisco the Engineering Record extends a cordial invitation to visit the McGraw Publishing Company's booth in the Palace of Machinery. Representatives will be in attendance to answer questions and to direct engineers to the chief places of technical interest in and near San Francisco. Any service which the Engineering Record can render to its readers at the Exposition will be undertaken gladly. Bound volumes of the paper for several years past are on file, together with copies of current issues and general literature issued from time to time. The other McGraw papers—Electrical World, Electric Railway Journal and Metallurgical and Chemical Engineering—also are represented. For the convenience of visitors a private office with desks and typewriters is maintained at the Record's booth and engineers will find this a convenient place in which to attend to their correspondence. Another feature of the exhibit is the stereomotorgraph which displays lantern slides of important engineering works. The aim of the exhibit is to indicate the character and scope of the McGraw publications and to offer to Engineering Record's friends a convenient headquarters during their visit to the Exposition grounds.

Los Angeles Pays $500,000 for Hollywood Water Distributing System

The lengthy controversy between the Board of Public Service Commissioners of Los Angeles, Cal., and the Union Hollywood Water Company over the purchase of the company's mains, meters and other property has been settled by a compromise on a price approximating $500,000. Heretofore the company has held out for $748,685, while the city bid $470,452. During the controversy, which commenced last July, 8000 water users in one of the finest residence suburbs of Los Angeles have faced the possibility of water shortage. The company desired to purchase aqueduct water when its own sources of supply became inadequate, but city officials refused to sell the water for distribution by a private company unless that company would agree to deliver to consumers at the same price paid to the city for the water. This was declared by the company to be in the nature of a confiscatory proceeding.

Alaska Railroad Commission Establishes Headquarters at Seward

The Alaska Engineering Commission has established headquarters in the former Alaska Northern Building at Seward, Alaska. W. C. Edes, chairman of the commission, arrived from Seattle, June 1, and department heads and clerks are now at work in the new quarters. The commission will take over the Alaska Northern Railroad July 1. The line now is open to mile 40 and gasoline cars are being operated over this section. A contract has been awarded for the cutting of a million and a half feet of Government timber at Portage Bay for use on construction work.

Change in Proposed Slab Formulas for New York Building Code

Owing to an error in the wording of the preliminary draft of the proposed revision of the New York building code, the editorial in last week's issue of this journal showing the low values of equivalent bending moments was inexact in its treatment of stone concrete. The proposed coefficients for stone concrete, given as 30,000 and 40,000 in the preliminary draft, have now been revised to read 16,000, 20,000 and 30,000 respectively to conform with the three cases considered for cinder-concrete filling. The corresponding values for bending coefficients are 13.7, 17.1 and 25.7 respectively. A clause on span of floor filling, limiting this construction to 8-ft. spans between beams, is intended to apply to reinforced concrete, either cinder or stone, as allowed by this article. The necessary requirements to ensure arch action is therefore provided.

News of Engineering Societies

The Water Power Congress authorized by the Oregon States Legislature will meet in Portland, Sept. 21, 22 and 23.

The Northwestern Road Congress, of which G. W. Cooley, State highway engineer of Minnesota, is president, will be held at Cedar Rapids, Iowa, Oct. 4-7.

The Royal Sanitary Institute (British) will receive essays on suggestions for improvements in the sanitary arrangements and appliances suitable on ship board for passengers and crew, and cattle and other live stock until Nov. 1, in competition for the Henry Saxon Snell prize of $255. Full details may be obtained from E. White Wallis, secretary, 90 Buckingham Palace Road, London.

The New England Waterworks Association will hold a joint field day and excursion with the Boston Society of Civil Engineers on June 16. There will be a boat trip to Nantasket, starting from Rowe's wharf at 10 a. m., and a baseball game between teams representing the two organizations. The committee for the New England association consists of Charles W. Sherman, W. E. Maybury and E. M. Blake, and for the Boston Society, E. M. Blake.

The Colorado Association of Members of the American Society of Civil Engineers will hold its annual meeting in Denver today. Frederick H. Brandenburg, district forecaster of the United States Weather Bureau, will speak on the methods used by the bureau in obtaining reliable data regarding the rainfall, precipitation in high altitudes, snowfall and water content as a basis for estimating the volume discharged by the streams, flood data, temperature, wind and other climatic conditions of the State. There will be no meeting during July or August, but the regular Wednesday luncheons will be continued throughout the summer.

The Chicago Association of Commerce, engineers' division, was addressed June 4 by Charles N. Green, engineer of subsurface conditions, New York Public Service Commission, on "Underground Conduit Conditions in New York." The division has selected a committee to investigate the conditions under which Government engineers and college professors do consulting work. A committee on publicity for local engineering works has been appointed and W. W. DeBerard, chairman, explained that effective work could only be accomplished by full co-operation of the members in getting items to the committee early, so that the story would have a news value, which would give the technical features of the item greater interest and a wider appeal.

Personal Notes

G. C. Pruet has been appointed city engineer of Miles City, Mont.

W. E. Minier has been appointed city engineer of Oakland, Vt.

John H. Parker has been appointed city engineer of Columbus, Vt.

Leon Briggs has been appointed city engineer of Webb City, Mo.

Joseph J. Armstrong has been appointed assistant city engineer of Butte, Mont.

Lee Highley, formerly chief engineer of the Pacific & Northern Railway, has resigned.

The Edmund T. Perkins Engineering Company, of Chicago, has opened a branch office in the Illinois State Bank Building, Quincy, Ill.

John Dwyer has been appointed superintendent maintenance of way of the Norfolk Southern Railroad, with headquarters at Norfolk, Va.

Paul D. Fuqua, formerly assistant engineer on the forces of the Morgan Engineering Company, of Dayton, Ohio, has been appointed assistant city engineer of that city.

Frederick Everett has been appointed acting State highway commissioner of New Hampshire, succeeding the late S. Percy Hooker, whose death was noted in this journal May 1.

R. F. Ragland, formerly in charge of drainage work in Ballard County, Ky., has accepted a position in the valuation department of the Wabash Railroad, with headquarters at St. Louis.

R. A. Van Ness, who has been taking graduate work at the University of Washington, is now engaged in railroad valuation work on the forces of the Interstate Commerce Commission.

F. N. Bingham, formerly superintendent of paving of the city of Spokane, Wash., has resigned to become a partner in the Clifton-Applegate Company, paving contractors of that city.

Charles P. Brinton, formerly road assistant for the Association of American Portland Cement Manufacturers, is inspecting shrapnel fuse for the Bethlehem Steel Company, at Bethlehem, Pa.

G. C. Brooking, assistant engineer on surveys of the Baltimore & Ohio Railroad at Baltimore, has accepted a position with the Interstate Commerce Commission, Division of Valuation.

R. C. Whitehead, formerly designer for Jacobs & Davies, consulting engineers, of New York City, has been appointed designer on the forces of the Niagara Falls Power Company at Niagara Falls.

A. L. A. Himmelstein, formerly engineer and inspector on municipal work for the city of Portage, Wis., has accepted a position on the maintenance forces of the Valier (Mont.) Land & Water Company.

John E. Lloyd, formerly assistant division engineer of the Baltimore & Ohio Railroad at Garret, Ind., has been appointed division engineer with office at Cleveland, Ohio, succeeding A. A. Jackson, resigned.

H. B. Emerson, formerly superintendent for the Curtis-Ward Company, general contractors, of Chicago, has been appointed chief engineer, with headquarters in the Law & Commerce Building, Bluefield, W. Va.

H. R. Carpenter, formerly engineer maintenance of way of the Missouri Pacific-Iron Mountain System, has been appointed assistant chief engineer, with headquarters at St. Louis, Mo., succeeding C. E. Smith, resigned.

Herbert M. Wilson has resigned from the office of engineer in charge of the Pittsburgh Experiment Station of the U. S. Bureau of Mines to become director of the recently organized Coal Mine Insurance Association.

Frank G. Cook, formerly assistant engineer on the forces of the Northern Pacific Railway, has been appointed roadmaster at Mandan, N. D., succeeding Christopher T. Sponsel, who has been appointed roadmaster at Garrison, Mont.

Otto H. Tittmann, formerly chief of the U. S. Coast and Geodetic Survey, received the honorary degree of Doctor of Science from Stevens Institute of Technology at the commencement exercises held in Hoboken, N. J., June 8.

W. F. Wilder, formerly draftsman in the construction department of the Erie Railroad in New York City, has been appointed computer on the forces of the Interstate Commerce Commission, Division of Valuation, at Washington, D. C.

A. B. Rutherford, who was engaged on the construction of approaches to the North Side Point Bridge for the City of Pittsburgh, is now located at Sharon, Pa., engaged in remodeling and enlarging the filtration plant for the Sharon Waterworks.

Charles S. Bilyeu, formerly New York representative of Colby & Christie, inspecting engineers, Philadelphia, has resigned to become manager of the inspection business of Hildreth & Company, consulting and inspecting engineers, of 15 Broad Street, New York City.

C. P. Noland has resigned from the office of assistant engineer, in charge of construction, of the paving commission of the city of Baltimore to be effective June 15 and has accepted an engineering position with the Tennessee Coal & Iron Company at Birmingham, Ala.

Frederick T. Elwood, formerly acting city engineer of Rochester, N. Y., has been appointed city engineer. He was appointed to the former office, Jan., 1914, when Edwin A. Fisher, then city engineer, was relieved of the detail work of the office and appointed consulting engineer.

Frank S. Lanagan, city engineer of Albany, and D. L. Turner, deputy engineer of subway construction, Public Service Commission, First District, were appointed members of the committee on city planning at the annual conference of mayors and other city officials of New York State, June 3.

Harry R. Crohurst, sanitary engineer, of the U. S. Public Health Service, has been transferred from Farnham, N. Y., to Cincinnati to work on the investigation of trade wastes and their relation to the pollution of the Ohio River, under the direction of Dr. Frost, passed assistant surgeon, who is in charge of the investigation.

T. H. Strate, formerly construction engineer on the double track work of the Chicago, Milwaukee & St. Paul Railway between Minneapolis and Aberdeen, S. D., has been appointed field engineer on the valuation work on the lines between Mobridge, S. D., and Butte, Mont., in conjunction with the parties of the Interstate Commerce Commission at work on these lines.

Charles U. Powell, formerly assistant engineer of the topographical bureau of the Borough of Queens, New York City, has been appointed engineer in charge of that bureau, succeeding Clifford B. Moore, who, as noted in these columns, April 10, was appointed consulting engineer of the borough, succeeding the late Foster Crowell. Mr. Powell has served in the topographical bureau since 1902.

Henry M. Waite, who was elected vice-president of the Dayton Engineering Club at its annual meeting, June 1, is city manager of the city of Dayton, which was one of the first cities with a population of more than 100,000 to adopt the commission form of government. Previous to his assuming that office, Jan. 1, 1914, he was chief engineer of the Department of Public Works of the city of Cincinnati.

Major G. B. Howell, Corps of Engineers, U. S. A., has been promoted to the rank of lieutenant-colonel to fill the vacancy caused by the promotion of Lieut-Col. H. C. Newcomer. Robert R. Ralston, Mark Brook and Lawrence V. Frazier, captains, have been promoted to the ranks of major. Cleveland C. Gee, John M. Wright and John R. D. Matheson, first lieutenants, have been made captains.

Edwyn E. Watts, engineer and constructor specializing in the design and construction of waterworks, railways, municipal improvements, the reclamation and protection of low lands adjacent to the Ohio River and tributary streams, and valuation of industrial plants and public utilities, has moved his offices from Princeton, Ind., where he has been located for the past fifteen years, to the Fletcher Trust Building, Indianapolis, where he will continue in practice along similar lines, giving special attention, however, to valuations.

R. L. Sackett, professor of hydraulic, sanitary and municipal engineering of Purdue University, has been appointed dean of engineering at Pennsylvania State College. Professor Sackett has been identified with Purdue since 1907, when he came to that institution from Earlham College, where he was professor of applied mathematics and astronomy. He has been sanitary engineer for the Indiana State Board of Health for several years. Three consecutive governors have appointed him on State commissions. Governor Ralston appointed him a member of the Indiana Highway Commission. He is also a member of the Lafayette board of public works.

George H. Biles, formerly engineer of maintenance of the Pennsylvania State Highway Commission, has been promoted to the position of second deputy State highway commissioner, suceeding E. A. Jones. Mr. Biles entered the service of the State Department of Public Works as a chainman in 1900 and advanced to the grade of principal assistant engineer within a period of four years. In 1905 he was appointed chief draftsman in the highway department and, in 1906, division engineer in charge of the central and some of the eastern counties of the State. He was appointed in 1913 engineer of maintenance in charge of approximately 10,000 miles of road.

A. F. Dorley, formerly principal assistant engineer of the Missouri Pacific-Iron Mountain System, has been appointed engineer maintenance of way, succeeding H. R. Carpenter, whose promotion to a higher grade is noted elsewhere in these columns. He was graduated from Notre Dame University in 1900 and began railway work as rodman on the Baltimore & Ohio Southwestern. In 1901 he was appointed assistant engineer on the "Big Four" and, a year later, returned, in the same capacity, to the Baltimore & Ohio. He entered the service of the Missouri Pacific in 1906 as assistant engineer and was appointed division engineer at Omaha, Neb., six months later. He attained the grade of principal assistant engineer in 1914.

Obituary Note

Herbert W. Cowan, chief engineer of the Colorado & Southern Railroad, died in Denver, May 29. He was graduated from Worcester Institute of Technology in 1882 and entered railway service in 1883 as topographer for the Chicago, Burlington & Northern. In 1888 he was appointed assistant engineer on the forces of the Union Pacific and, in 1894, resident engineer on the Union Pacific, Denver & Gulf. He was appointed chief engineer of the Colorado & Southern in 1898.